THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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POWER SUPPLY ON THE RAND.

THE description given elsewhere in this issue of the huge undertaking which has been developed on the Rand will be read with interest by all who desire to make themselves acquainted with the methods adopted for the supply of electrical energy on the grand scale; it is by far the largest of its kind in the British Empire, and has few rivals in the world in point of magnitude and output, though the distance over which the energy is transmitted is not great. It is noteworthy that so high a pressure as 80,000 volts has been adopted for transmission over 35 miles, though the rule generally accepted as to the appropriate voltage—a rough rule, it is true, but fairly well conformed to—would have given only half this pressure. Probably the exceptionally favourable condition of a dry climate, and the known fact that lines insulated for pressures over 50,000 volts are less liable to trouble from lightning than lines at lower voltage, had a good deal to do with the choice, which has been completely justified by the result.

While we have in this country no undertaking comparable in magnitude with the Rand power supply, it does not follow that we have nothing to learn from the work that has been done by the company's engineers, who, although beset with exceptional difficulties of transport, labour, &c., have triumphed over all obstacles, and have adopted methods which in several respects deserve our careful study. The arrangement of the boiler house in bays at right angles to the engine room, brought about by the adoption of the turbine, and the employment of transformers coupled directly to the terminals of the generators, were prominent features of the practice introduced by Messrs. Merz and McLellan in connection with the Tyneside electricity supply, the only undertaking in this country which appears to resemble that of the Rand at all closely, and the high compliments paid to the Merz-Price system of protection of mains by the author of the paper further emphasise the association of ideas embodied in both schemes. The system of boiler draught employed, however, is an entirely new feature; the difference between this and the ordinary induced-draught system is not apparently very great, yet it suffices to effect a very marked improvement in the results obtained, and Mr. Hadley's claim that the chimneys are "absolutely smokeless" will be noted with interest by engineers who suffer under—or should we say violate?—the local by-laws in this respect. Further details regarding this part of the plant would be welcome.

Perhaps the most remarkable feature of the working of the plant is the enormous output, which will, at no distant date, be about 2,000,000 units a day, or nearly five times as much as our largest railway output. This, too, is given at the extraordinary load factor of 70 per cent. and upwards—a figure to make a central-station engineer's mouth water. Under these circumstances, the price of ·525d. per unit, as Mr. Highfield pointed out, at first appears somewhat high; but when we make due allowance for the high capital and running costs on the Rand, and the fact that this is the maximum price, we may fairly assume that the actual price is equivalent to not more than ½d. in this country. In fact, it comes within measurable distance of the condition foretold by Dr. de Ferranti, when electricity for all purposes will cost only ⅛d. per unit, and we shall have generating stations here far larger than those on the Rand.

It is exceedingly significant that the owners even of large mines have found it expedient to scrap their own plant, and to take their supply of power from the company's mains.

The same process is in progress here, but far more slowly; the relative cost of electricity is still much greater here than on the Rand, and manufacturers have not at command that ready flow of capital which stimulates enterprise and enables great economies to be effected by drastic changes, where it is available.

The extended use of compressed air, supplied in bulk on an unprecedented scale, is another feature peculiar to this unique undertaking. Although a great part of the air supply is derived from electrically-driven compressors, the intervention of this non-electrical medium can hardly be pleasing to the electrical engineer who loves his calling; but obviously it must be accepted, at any rate until electrical rock drills and other mining machinery have reached a more advanced stage of evolution.

The one consideration which we cannot but regard with deep regret is the fact that so large a proportion of the plant employed was built by foreign hands. The circumstances which led to this unfortunate result are known to our readers, and we need not further comment on them, but seeing that the turbo-alternator and the turbo-compressor were developed almost wholly by Sir Charles Parsons and his staff, it seems a great pity that this work should have gone abroad. For this the engineers were not responsible; their part of the work reflects the greatest credit upon them, and we congratulate them, as well as the managing director, Mr. A. E. Hadley, upon the successful accomplishment of a gigantic task.

THE STATE AND THE ENGINEER.

In these days, when the development of engineering—in all its branches—is progressing with ever-increasing rapidity from one vast scheme successfully carried out to another of even more ambitious character, to be equally successfully accomplished in its turn, it would be well if attention could be brought to bear on the whole broad question of this development.

The one object of engineering is the more efficient working of the world; and, of course, this is attained by perfecting, so far as is reasonably practicable (to quote the words of the Home Office), the efficient working of communities, towns, and countries, which are the world's component parts. This is true, to a certain extent, of all professions, but particularly so of engineering.

Is development taking place along right lines? Is there any continuity of policy or purpose in the carrying-out of the great enterprises of the present time? The question of development along this or that line is almost always a matter of circumstances and individual judgment. The result of this is that the second question must be answered in the negative.

That being so, we naturally ask ourselves what can be done to improve matters? The *Canadian Engineer*, in its issue of January 23rd, 1913, contains some interesting articles bearing on the subject. Mr. T. Chase Casgrain, chairman of the International Joint Commission, some time ago offered two prizes for the best essays on "The Formation of a National Engineering Service." The essays which obtained the first and second prizes are printed in the issue above-mentioned. The first, by "Evolu," is entitled "A National Board of Engineering Control"; and the second, by "Observer," is called "The Organisation of a Corps of Civil Engineers for Public Works Services in the Dominion of Canada."

The first essay concerns itself almost entirely with the development of the natural resources of Canada through the instrumentality of the Board of Control. Railways, harbours, docks, ports, canals, irrigation, water power, surveying, and architecture, are all brought within the scope of the suggested Board, and the fundamental idea and method of working of the Board are expounded in a lucid manner deserving of careful attention.

"Observer" makes a general survey of public engineering departments throughout the British Empire and the United States, after considering which, he outlines a scheme for the Canadian public works service. This is also a very thoughtful essay, in that it bears evidence of much investigation of detail.

In the first essay, "Evolu" suggests a Board of five directors, responsible to Parliament, and appointed for an unlimited period, with retiring pensions after a specified number of years. Each director on being appointed would hand a formal signed and undated resignation to the Governor-General in Council, so that only Parliament could remove any director from his position; the Governor-General would fill in the date of resignation when it was decided by Parliament. Vacancies would be filled by the Board itself, either by promotion or appointment. Under the Board would come, with their staffs, the auditing engineer, the chief engineer of railways (we are taking the order in which they appear in a table given in the essay), the chief engineer of marine service, the chief engineer of harbours, the chief architect, the chief engineer of surveys, the chief engineer of canals and water service, and the secretary.

The auditing engineer would be responsible for the important work of collecting and tabulating information. This would indeed be a boon, and would probably do more than any other single thing to secure constant progress and to avoid the recurrent commission of the same mistakes. Now that Mr. Edgcome is again President of the Incorporated Municipal Electrical Association, we may hear more of the information bureau which he suggested in his former presidential address, delivered at Kingston-on-Thames in 1906. The notion was turned down by the Council because they thought it beyond the scope of the Association, but it is a work that someone ought to do, and "Evolu" suggests what he calls the auditing engineer, with a technical librarian to assist him.

Much time, energy, and money are wasted, when tenders are invited for various schemes, by letting each tendering firm prepare and submit its own design. Designing, under the scheme, would be carried out by the Board's engineers, thus avoiding the loss incidental to the preparation of half-a-dozen or more designs, only one of which can be accepted, while all have to be paid for, directly or indirectly, by the buyers as a whole. Power actually to carry out the work by direct labour is suggested, but we do not think this is advisable or necessary. The Board should be a Board of Control—a Direktion, to use the German word, for which we have no equivalent—and not a Board of Works.

If this idea were carried out, engineering would be co-ordinated as the law is co-ordinated now. There would be uniformity of direction and continuity of purpose, and an entire absence of that haphazard working and that lack of coherence which are too often observable under present conditions. Heaven forbid that engineering should become as inelastic and difficult to set in operation as the law, but the idea is right.

From the idea of a Board of Control, it does not seem to us a long distance to a greater organisation of engineering as a whole, but we must reserve the further development of this conception for another article.

Whether the scheme, as outlined, will ever receive the sanction of the Canadian Parliament, or whether it will ever be brought before them at all, are matters which lie on the knees of the gods. It is obvious, as the *Canadian Engineer* points out, that appointments would be more likely to be made upon a strict basis of experience and ability, unaffected by political considerations. If this were done in Governmental matters, we should have public work carried on with something approaching the economy and efficiency of a private business undertaking. With proper care, the performance of some private undertakings might even be surpassed.

The notion has much to recommend it, and we hope that it will receive due public attention on both sides of the Atlantic Ocean.

Celluloid Regulations.

A letter which appears in our "Correspondence" pages to-day serves to emphasise the need that exists nowadays for manufacturers and traders to be on the alert to prevent regulations which are drafted for the public good operating with needless hardship upon the interests of industry and trade. Remembering the grave fire risks that may attend the uncontrolled storage of celluloid and celluloid goods, everybody will agree that the time is fully ripe for better pre-

cautions to be introduced; and better precautions can only be enforced generally by means of regulations which receive the sanction of the Legislature. But those who draft such regulations are in danger of being influenced more by humane desires than by knowledge of, or regard for, industries which may be quite unnecessarily, and may-be inadvertently, placed at a serious disadvantage; if the regulations are of too sweeping a character they may militate against the public interests as well as against those of private parties. There may be room for a little more considerate drafting without the main intentions concerning the lessening of fire risks being in the least degree defeated. The L.C.C. General Powers Bill, if allowed to pass in its present form, will enable the Council to enforce regulations for all premises in the county in which celluloid and other inflammable substances are kept for sale in quantities exceeding 10 lb. in weight. There is also a clause in the City of London Bill defining as a "celluloid shop" any premises whereon the aggregate celluloid kept "handled or otherwise dealt with (otherwise than for the purpose of being manufactured or employed in or subjected to any process of manufacture)" at any one time exceeds 10 lb. in weight. A celluloid shop has to be licensed and inspected and otherwise subjected to specified conditions. It hardly needs pointing out that this will involve every retail or wholesale accumulator dealer, and numerous traders in hardware and other goods! Unfortunately, it is too late for the battery makers or any other section of the electrical industry to take direct collective action in opposition, but the way is open for strong action to be taken through the medium of those who have already lodged petitions, and are sure to be heard. We draw attention to this matter, hoping that those sections of our trade which are likely to be adversely affected without sufficient reason will co-operate with Mr. Brooke, the railway companies, Chambers of Commerce and others, in order to ensure that the final wording of the clauses shall be fully effective, without being a needless handicap to trade and industry. It is expected that the second reading of the Bills will take place on Monday, 31st inst., and they will then go to the Local Legislation Committee, where they will probably be discussed on or about April 15th, when opposing petitions and arguments by counsel will be heard. It will be understood, therefore, that those who mean to take action must do so at once.

The E.T.B.I.

On Monday next the annual meeting of the Electrical Trades Benevolent Institution takes place at the Institution of Electrical Engineers, with Mr. E. Garcke in the chair. The annual report to December, 1912, which will then come up for adoption, after expressing regret at the loss of a colleague and liberal supporter in Sir J. Irving Courtenay, shows that the income for the year was less than in 1911, as that was an exceptional year, inasmuch as there was a legacy received, as well as the balance of the Olympia 1905 Exhibition proceeds. A donation of £250 from the B.E.A.M.A. is, however, among the receipts for 1912. The total income for the year was £954, as compared with £1,101 for 1911, but it is important, as evidence of the wider interest taken in the Institution, that there was a marked increase in the number of persons subscribing, as well as in the amount of subscriptions; the latter is now more than four times the total of the preceding year, while the ordinary donations are also considerably more. The result of the year's work is a net income of £754, £150 of which has been placed on deposit at the bank, and £569 invested in Canadian 3½ per cent. registered stock, bringing the total of the invested funds to £3,968.

The report contains a regret—not that so few electrical men have died during the year—but that so far only one legacy has fallen to the fund. By way of comparison with other institutions, it is mentioned that one such benefited in 1911 to the extent of over £18,000. Perhaps the youthfulness of our organisation is responsible for this difference, or it may be that those who have the wherewithal to bequeath good round sums and have the mind to do it too, do not die; or, again, that those who have the mind to do so, and have shown a real interest in the progress of the movement, have not the wherewithal to do it if they do die. But whichever way it be, we are hopeful that the timely hint of the Committee will carry effective weight with those of maturer years who have been fortunate enough to accumulate enough and to spare, and will also be borne in mind by more youthful spirits who may draft their wills, if only in hope of future ability, in such a manner that the secretary 10, 20 or 30 years hence, will be able in his own advancing years to say nice things about them and the benefit that their generosity has brought to the Electrical Trades Benevolent Institution, enabling it to grant pensions to many who were little more than beginners in the industry when the fund was first launched. The rules introduced in 1912 and the creation of a class of "members" have produced satisfactory effects, and at the end of 1912 there were 30 life members and 78 ordinary members. Efforts are being made, as some of our readers in London know, to stimulate interest among employés by means of entertainments, and during the current year this movement may be carried forward in a number of other centres. We hope that it will meet with success. The appointment of collectors in individual firms to receive members' subscriptions by instalments, in addition to being a convenience, will also answer the same useful purpose of popularising the fund and its objects. The life assurance scheme already referred to in our pages is intended to appeal particularly to juniors. The grants made from the fund during the year numbered eight, aggregating £71, but these figures do not convey any idea of the amount of investigation of circumstances that fell to the lot of the committee, nor do they indicate the real value of the Institution. In addition to meeting such temporary needs, the great work of those responsible lies in building up resources in preparation for the happy day when it will be possible to grant pensions. The annual dinner takes place next month, and we hope that our readers will do their utmost on this occasion—under a magnificent lead from Mr. George Sutton, a present-day leader in the industry—and add to the fund such an amount as will worthily represent the prevailing very active state of the electrical trade. It might be interesting for the guidance of would-be donors and legators if the committee were to say approximately what figure it has in mind—if any—as being required before the pension day can dawn.

Striking Companies in Turkey.

Although the difficulties to be referred to may have been overcome by the present time, it is yet of some interest to learn how two foreign companies in Turkish towns, far from the seat of the war, have been treated by the municipal authorities and the native population. In the first place, according to the Beyrout correspondent of a German newspaper, the Belgian Société de Tramways et Eclairage Electrique suspended the lighting system in Damascus because the municipal authorities were in arrears to a large amount in the payments to the company, and put off the company from day to day with an allusion to the empty coffers. Thereupon a large crowd attacked the company's administrative premises for two days in succession, smashed the windows, and fired revolvers without, however, the authorities taking any serious action against the demonstrators. Several tramcars were also entirely destroyed, whilst the windows of others were broken. The second case refers to the Beyrout Gas Co., which, at the time of the correspondent's letter, had already suspended working for three weeks on the alleged ground of the scarcity of coal, the imports of which have been rendered difficult through the war. In reality, however, the Municipal Council owed the company a large sum for street lighting, which the latter was unable to collect. Not only so, but the native population has diverted large quantities of gas, and the authorities have done nothing to bring the thieves to book. The whole of the city, with the exception of a few streets where electric lighting has been temporarily introduced, has been in complete darkness at night, and the police authorities have issued an order advising the use of lanterns by persons who go out after 8 o'clock in the evening.

D

COST AND EFFICIENCY OF DISPLAY LIGHTING.

By L. CROUCH.

In connection with the articles on "Ornamental Street-Lighting Poles" (Electrical Review, March 22nd and July 19th, 1912), particularly as applied to "display" lighting in main business streets, various critics have urged the high cost of installing and operating such systems. However, the best proof of the pudding is well known, and the fact remains that the type of display standards, and the system of street lighting described in these earlier articles, continue to find increasing application in American cities. Nor do we find any digestive difficulties after the pudding has been eaten! The systems continue—as they commenced—to give every satisfaction, and practically every city which has adopted display lighting continues rapidly to extend its installation. There are, at present, three or four hundred towns in the States and Canada employing rolled metal and concrete standards, carrying tungsten lamps in diffusing ball globes, for the lighting of their main thoroughfares.

The cost of display systems is, in America, generally divided between property owners and the city authorities in a varying proportion, but, in many cases, the supply station has borne a large fraction of the expenditure. Owing to the advantage of brilliant frontage illumination in shopping districts, there is rarely any difficulty in collecting the major part of its cost from business proprietors, and, in a few American cities, the total cost is commuted to a tax against the properties as a permanent improvement. In the case of promenades and parks, &c., the local authority must, of course, bear the whole cost of the scheme, this being then purely for the public benefit.

A certain amount of specific cost data (both as regards installation and maintenance) was presented in the July 19th, 1912, issue of this journal, and readers will doubtless be interested in the following supplementary figures referring to some more recent installations in various American cities.* Only those cases are here considered for which fairly complete data are available as to the exact nature of the equipment.

It is obviously impossible to prepare cost data which shall be universally applicable, since local conditions and the design of standard adopted are, of course, very variable. The following costs, however, may be regarded as representative for one of a number of 5-light ornamental standards of the type illustrated in figs. 1-6, p. 479, 1912 :—

Pole	£7	0	0
Lamps and sockets	1	2	6
Globes	0	16	0
Erecting and wiring post and concrete foundations	1	12	0
65-ft. supply cable (lead, jute and steel) ...	3	5	0
Laying cable	7	16	0
Total	£21	11	6

The labour costs assume that the cable has to be laid below an existing concrete sidewalk, and all the items should be somewhat lower in this country.

Turning to particular cases, the data summarised in Table I show the conditions and results in a number of recent American installations. A cheap but very effective system, which has been adopted in residential quarters in Toronto (Ont.), provides light wooden poles along the inner edge of sidewalks. Each pole (which carries supply wires on insulators near its top) is provided with a cast-iron lantern containing a 150-watt tungsten lamp, screened by an 8 in. × 8 in. Alba-glass cylinder. The illumination provided is economical, novel and sufficient for residential needs.

The data in Table II refer to illumination measurements made at 3 ft. above ground level in the line joining adjacent 5 × 100-watt tungsten standards in Indianapolis.

*Actual day and night photographs and more complete particulars of these installations are to be found in the *Southern Electrician*, pp. 448 *et seq.*, 1912.

Finally, the figures in Table III refer to the energy expenditure per linear foot and per square foot, and the average foot-candles horizontal illumination provided in typical "display" street-lighting systems in four prominent American cities. For comparison are included corresponding data derived from Bloch's measurements in Berlin streets lighted by A.C. and D.C. arcs.

TABLE I.—American "Display" Lighting Installations.

Town.	Seattle (University Campus).	Minneapolis.	Hamilton.	Pine Bluffs.	Atlanta (N.Y.).	Chicago.
Type of standard	Reinforced concrete ornamented	Iron	Iron	Simple iron pipe.	Ornamental iron	Reinforced concrete, bronze ornaments
No. of standards in use.	78	—	—	150	102	591
No. of lamps per standard.	1	5	5	4	5	1
Spacing of standards.	—	100	ca. 60	—	65	—
Watts per lamp.	100	100	100	100	4 of 60 1 of 100	490*
Capital cost per standard.	£7 14s. †	£38	£16	£4 16s.	£28§	£16 8s. †
Operating cost per standard per annum.¶	—	£12	£2 8s. per foot frontage.	£7 4s.	—	—

* In this case, 7½ ampere series Jandus lamps (490 watts, 1,000 hor. c.p.) are used; tungsten lamps are employed in all other cases mentioned.
† Including proportion of central station equipment, posts, lamps and globes complete, erecting, supervision and tools.
‡ Bare pole, £2 18s.; foundations, &c., £1 4s.; ornament, lamps, globes, transformers, &c., £3 5s.; total labour (students), 7s.; castings made in College foundry.
§ £18 for poles, £10 for distributing system.
¶ Including attendance, maintenance and electricity supply.

TABLE II.—Illumination Data.

Feet from post.	Foot-candles illumination (3-ft. level). Crystal roughed inside globes.	Alba glass ball globes.
0	0·34	1·40
5	0·28	1·05
10	0·18	0·50
15	0·10	0·21
20	0·06	0·12
30	0·03	0·06
40	0·02	0·04

Obviously—as would be expected—the best modern systems of arc lighting are more efficient, from the illuminating standpoint, than the ornamental tungsten schemes considered above, but the American display standards (which are also applicable and have already been applied to magnetite and Jandus flame arcs), provide an effective display illumination which can be achieved by no other system. The point—which has been indubitably made in American installations—is that the end justifies the means.

So recently as two or three years ago, ornamental or display lighting was regarded in the States as an expensive luxury which would probably be adopted only by private individuals or for the external lighting of public buildings.

TABLE III.—Energy Expenditure and Average Illumination.

	Watts per linear foot.	Watts per square foot.	Average horizontal foot-candles.
Dayton (Ohio)	8·71	0·173	0·092
Indianapolis	12·8	0·211	0·179
Toronto (Ont.)	9·85	0·235	0·175
Buffalo (N.Y.)	5·68	0·095	0·093
Ordinary D.C. arcs (Friedrichstrasse)	8·4	0·116	0·57
D.C. Flame arcs (Potsdamer Platz)	7·5	0·111	1·57
Ditto (Alsenbrücke)	6·1	0·218	1·55
A.C. Flame arcs (Hardenbergstrasse)	6·96	0·055	0·32

It was certainly not expected that the system would be employed to light entire business sections of large cities. This is almost exactly the point of view at present adopted in this country. Pavement display lighting standards have been already installed by a number of progressive business firms and hotels and, to a limited extent, by public authorities for public buildings. Surely it is reasonable to anticipate that, at no distant date, the proprietors or tenants of whole shopping areas will co-operate to provide display lighting for the whole of their main frontages. Artificial light is cheap enough in these days, and the cost of its provision

would be more than covered by the increased popularity and prosperity of the business districts providing it in pleasing profusion. After the business areas would follow promenades and the better-class residential quarters, particularly in holiday resorts.

Undoubtedly the whole proposition offers important possibilities to business men generally (and hence to the whole community), to manufacturers and contractors, and to central-station engineers. There is involved no question as to the relative merits of gas and electric light. What is required is display illumination along certain lines, and, in providing this, the relative positions of gas and electricity remain as in ordinary domestic or street lighting. The most favourable field for the development of the new system in this country is in those provincial towns which are to-day behind the times. In large cities, which have already adopted other costly lighting schemes, no change can at present be hoped for, except as a result of purely private enterprise.

CO-OPERATION BETWEEN PRIVATE AND PUBLIC SUPPLY SYSTEMS.

[COMMUNICATED.]

At the present day the keynote of industrial progress is the elimination of waste products and the development of such products as marketable commodities or by-products of the main operation.

It is only comparatively recently that emphasis has been laid upon this side of engineering activity, and it is therefore hardly to be wondered at that, so far, the full value of research in this direction has not been appreciated. There is always a tendency on the part of manufacturers, whether large or small, to look after the interests of the moment and to leave the larger affairs which may culminate many years hence to look after themselves. Hence, such subjects as the conservation of the world's supply of energy are often regarded as a matter of academical interest only. When, however, it can be shown that such conservation in reality means pounds, shillings and pence at the present day, the matter assumes a live interest.

It is from this point of view that we propose to treat the relative position of the large centralised power plant and the groups of independent systems which are to be found in the areas served by a centralised supply. It is immaterial at the present stage to discuss whether these independent plants consist of steam engines with mechanical power transmissions, gas engine plants, or miniature electric power transmissions. The point to note is that in a given area we have a large centralised power supply, of which full use is not made, as evidenced by the existence of private plants. Is the proper relative attitude of these two sections that of competition or of co-operation?

In the United States, especially in the large cities, geographical disposition has proceeded in the vertical rather than in the horizontal direction. In other words, as the city has grown, more storeys have been added instead of more streets built. Hence, in comparatively small areas, we have great density of industrial operations and a correspondingly sharp conflict between centralised systems of power supply and private plants operating building blocks. The outcome of this is that the question of co-operation or competition has reached a very acute stage in America, and our contemporary, the *Engineering Magazine*, publishes in its January issue an interesting article, by Mr. Percival R. Moses, on "Practical Co-operation between Central Station and Isolated Plant." We propose to deal with this article more as an indication of the line of thought which is being actively pursued in America than to rigorously examine the arguments in detail, inasmuch as in this country we are not confronted with the large office block problem so much as with that of the congested manufacturers' district, and hence the problem is somewhat different in detail.

Broadly speaking, however, the British problem follows somewhat similar lines. The British manufacturer is now becoming alive to the importance of utilising his waste products, using the term in its broadest sense. In the blast furnace, for example, he is no longer content to allow the waste gases, in a highly-heated condition, to pass away to the atmosphere. He utilises both the heat and the chemical constituents in power and heating in conjunction with the rest of his plant. He eliminates frictional waste by scrapping complicated mechanical transmissions in favour of a private electrical plant, and in connection with this plant he does not seek to maintain an expensive independent staff, but endeavours, so far as possible, to utilise men who can also be employed on other duties. If the works process is one which can be kept going evenly and continuously for a long number of hours per day and throughout the year without fluctuations, the manufacturer has reached, so far as his power production problem is concerned, a point of efficiency which it will take the central station supply a very long time to beat.

It is, however, precisely at this point where the private plants in a good many cases fail, because, owing to the requirements of manufacturing processes, the constant and regular demand on the power plant cannot be maintained. In other words, the private plant is at one instant overloaded, while at another time it is working at considerable inefficiency, owing to little or no load being placed upon it. Here, then, is the opportunity for the equalising effect of the large diversity factor of the public supply system, and it is here where co-operation can, with the greatest advantage, take place between the small power station and the large system. If we regard the large power system as a means of transferring super-abundant power available at one point to another point where there is a super-abundant demand, and the generating station itself as a species of storage reservoir capable of giving the necessary balancing action, we have what may be claimed as a practically new ideal of the co-operation of public and private supply, and yet one which it is practically certain will become more and more realised as time goes on.

This idea is by no means chimerical, nor should it be dismissed without careful consideration. The time is even now ripe for, at any rate, the first steps to be taken in the direction of such co-operation, because the centralised power supply systems are finding that as they widen their area the cost of transmission from a central point is becoming a more and more serious item. Even at the present day, cases are not wanting where, in preference to extending the capacity of an existing generating station to meet increased needs, further generating stations are being built at various points on the supply system, these generating stations working together and transferring energy from one to the other point as required. A still further step has been taken in the erection of such supply stations actually adjacent to industrial works, and deriving from them the necessary power to drive the electrical plant. If this process is extended, the final step is easily reached of having an extensive, and yet cheap, because not too bulky, transmission system, when one or two large power stations act as centralised or buffer supplies of power and a large number of smaller plants belonging to private manufacturers take energy from, or feed into, the common system, according to their individual requirements at any time. The importance of this on the cost of transmission is very great, because under competition conditions, in which the central station is trying to oust all individual plants in its area, the mains must be of sufficient size and capacity to carry all the power necessary over all the area without undue loss in transmission from the central point, while if co-operation is adopted, a large number of widely scattered sources of energy feed into the distributing system at many points, and hence the sum distance of transmission from the point of generation to the point of application over the whole area and throughout the whole year is less than if all the power had to be developed at one point, and therefore the cost of the transmission system taken as a whole will be less.

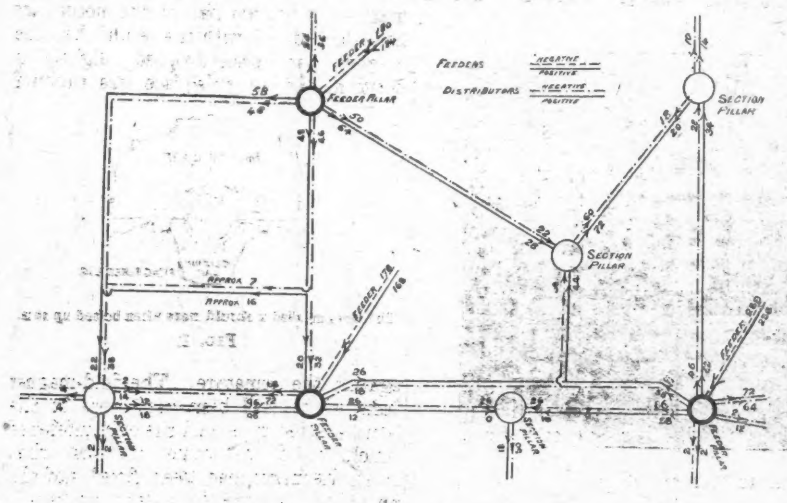
There is yet another point which bears upon the matter. In the central station, as pointed out by Mr. Moses, the by-product of the condensed steam from the engine or turbine, that is to say, the heat abstracted from the steam by condensing, either passes away to a river in the circulating

water, or is dissipated into the air by means of cooling towers, whereas in a large number of industrial processes the exhaust steam from the engine can be utilised in auxiliary service, such as heating buildings, warming die vats, &c. Where the private plant is of a modern description and of decent size, the value of such auxiliary services goes a long way to compensate for the fractional increase in efficiency due to the larger sizes of units used in the central power house, more especially when losses in transmission are taken into account. Further, the central station staff is occupied solely in producing the one thing, electric power; in the private plant, the staff is often used more efficiently because its labour and salary are distributed not only over the electrical production, but also over other manufacturing processes as well. These points all tend towards the realisation of an increasing overall efficiency if co-operation can be substituted for competition, and there is no doubt that in the future much more will be made of this point than has apparently been the case in the past. It would be well, therefore, if means could be found for the discussion in an impartial and business-like manner between the owners of private plants and the engineers of large public companies for the purpose of instituting a real attempt to secure co-operation, more especially in the large industrial districts, with a view to joining forces as far as ever possible to minimise industrial waste.

A METHOD OF TAKING LOAD TESTS ON MAINS.

By J. B. MORGAN, A.M.I.E.E.

When a distribution network has been laid down a few years and begins to get fairly loaded up, it is, of course, desirable to know exactly how the load is distributed among the various cables radiating from a feeder or section pillar.



Various devices have been brought forward from time to time to enable such records to be taken, but to those mains engineers who make liberal use of section pillars as well as feeder pillars, if they will only go to a little trouble from the start, a handy means of carrying out such load tests is always available. The only trouble to be taken is that of standardising on a certain length or type of switch fuse.

In the particular town I am interested in, not only are we liberally supplied with feeder pillars, but at all important street junctions we are using section pillars in place of the usual three or four-way disconnecting box, and our switch fuses are all of one particular make. The method of procedure was as follows:—

A switch pillar was fitted up in the test room and known currents were passed through a fuse; the fall of potential in millivolts between top and bottom of the fuse at various loads was taken after giving sufficient time at each different step to obtain normal temperature. A curve was then plotted from the readings thus obtained.

On a single copper wire fuse mounted under working conditions the millivolt drop was found to be as follows:—

No. 16 S.W.G.		No. 18 S.W.G.		No. 20 S.W.G.	
Load.	*Drop.*	*Load.*	*Drop.*	*Load.*	*Drop.*
2 amperes	3·3 MV.	2 amperes	5·5 MV.	2 amperes	10·2 MV.
4 „	6·5 „	4 „	11·6 „	4 „	20·0 „
6 „	9·7 „	6 „	18·0 „	6 „	30·2 „
8 „	13·0 „	8 „	24·0 „	8 „	40·4 „
10 „	16·4 „	10 „	30·2 „	10 „	50·4 „
20 „	32·6 „	20 „	61·0 „	12 „	61·5 „
30 „	49·2 „	30 „	101·0 „	14 „	72·4 „
40 „	68·0 „	40 „	160·0 „	16 „	83·1 „
50 „	91·9 „	—	—	18 „	93·3 „
60 „	121·8 „	—	—	20 „	106·0 „

It will be seen from these figures that even when the fuses are working with small loads a good deflection is obtained.

This was done for each size of fuse wire in use, and from the curves obtained it is now possible to go to any pillar, take the millivolt drop across the fuses, note the size of fuse wire, and a reference to the curve gives at once the current passing, and also, as we are D.C., the direction of the current, whether into or out from the bus-bar.

It has been found in practice that such a series of readings is wonderfully accurate. In recent tests the sum of the currents ascertained to be passing through the fuses along the various distributors agreed not only with the measured current passing through the feeder fuse, but also within 2 per cent. to 5 per cent. with the feeder ammeter readings on the station switchboard.

It will easily be seen that millivolt readings like these can be taken very quickly, as it is sufficient to press the contacts of the voltmeter leads on the binding screws of the fuse, making it possible to take a complete set of readings at one feeder pillar in a very few minutes, and without disturbing cables and fuses.

From these figures a diagrammatic map of the mains can be made which will not only show the total load on the cables, but also will enable one to see where out-of-balance occurs. It also shows which mains are feeding or are being fed at interconnecting points, and it enables the mains engineer to work out a scheme whereby, in the event of having to run with each feeder supplying an isolated network, he can see how the distributors require grouping, so that each feeder takes up its proper share of the station output.

In taking the test for curves, and also the first records at the pillars, it is advisable to start with new fuses, as it will readily be seen that a deteriorated fuse will give a greater millivolt drop for the same load.

This test is also helpful in detecting a loose fuse contact or a deteriorated fuse at any time after having obtained an average of readings for the different distributors and feeders on good fuses.

A diagram is appended showing how such results can be plotted out, and the arrows show whether the mains are receiving current from, or are feeding into, the bus-bar in the pillar.

Insulated Aluminium Cables.—The British Aluminium Co., Ltd., inform us that the Paris Omnibus Co. have just placed an important contract for armoured aluminium cables for tramway feeder networks. The cables will have cross-sections up to 1,000 mm.² (1·55 sq. in.), and are for a pressure of 500 volts. The order comprises some 300 tons of metal, and is expected to show an economy of 8 to 10 per cent. as compared with the cost of copper cables. Including cables already installed of a net weight in aluminium of about 300 tons, this company's system now has in service or on order insulated cables employing a total of 600 tons of aluminium.

A MARCONI TRAINING SCHOOL.

As a natural result of the rapid extension of wireless telegraphy the demand for trained operators has outrun the supply, and Marconi's Wireless Telegraph Co., Ltd., has been hard put to it to secure a sufficient number of them to take charge of the numerous installations which it is fitting on board ship, and in foreign countries. When the company entered into possession of its palatial headquarters in the Strand, in May last year, it set apart

Fig. 1.—Wireless Telegraph Training School at Marconi House.

space on the top floor of Marconi House for a school for the training of wireless operators, with accommodation for 60 students at day and evening classes, and already 130 of the students have passed the Postmaster-General's examination since the opening of the school, and have obtained employment in the company's service. The classes proved so popular that the space available was taxed to the utmost soon after the school was opened, and it became urgently necessary to provide increased accommodation; the school was, therefore, transferred to the basement, where room was found for 125 students, and when we paid it a visit last week the space was fully occupied. We give herewith a view of the room in which lectures are given in the theory of wireless telegraphy by experts; a number of the students are also engaged in transmitting and receiving messages in the Morse code. We illustrate also the instrument room, which is equipped with a 5-kw., a ½-kw., and a 1½-kw. set of apparatus, of the standard types made by the company; here the students are taught to operate Marconi apparatus of the type installed on board ship, and to carry out repairs and adjustments.

Students attending the day classes have generally had some experience with land lines or cables, and are able to acquire a working knowledge of the Marconi system in a couple of months; whilst they are learners they receive pay at the rate of 17s. 6d. a week, and after obtaining the Postmaster-General's certificate of proficiency and passing the examination set by the company's instructor, they are drafted into the service of the company. The commencing salary of a wireless telegraphist is £1 a week and all found on board ship, with an annual increment of 2s. 6d. per week to a maximum of 30s. per week. On promotion to the rank of senior telegraphist, the commencing salary is 35s. a week and all found on board ship—f.o.b., so to speak—with an annual increment of 5s. per week to a maximum of 55s. Promotions are made to higher grades when vacancies occur, according to seniority. Candidates for admission as pupils in the evening classes have to be between 19 and 24 years of age, and must have had previous business experience; the classes are held on three evenings a week, from 7.30 to 10 p.m. Each pupil pays a fee of 2s. 6d. a week until he obtains the Postmaster-General's certificate and joins the staff of the company, when the total amount of the fees paid by him is refunded.

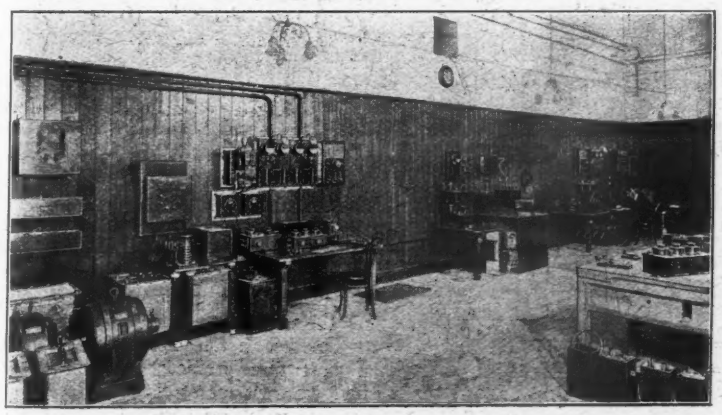


Fig. 2.—Instrument Room at Marconi House.

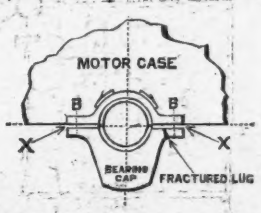
The arrangements made for the instruction of the neophytes appear to be very effective, and being trained with apparatus identical with that which they will handle after leaving the school, they can confidently proceed to take up their appointments without fear of finding themselves at sea, in a double sense.

The company is anxious to extend the benefits of the training to the Territorial Force, Cadet Corps, the Church Lads' Brigade and the Boy Scouts, and therefore not only will the *Wireless World* contain a series of special articles on the subject for their benefit, starting with the April number of the new magazine (the successor of the *Marconigraph*, as already mentioned in our pages), and running for 12 months, but examinations will be held at suitable centres and valuable prizes will be offered, as well as certificates of proficiency in connection with the portable field apparatus. The company or troop which furnishes the largest percentage of certificated members will receive a complete set of Marconi field telegraph apparatus. Further, free tuition in the working of the system will be given at the London School to the Boy Scouts on two evenings a week, which should enable the boys, after about three months, to pass the examination for proficiency which will be held.

The company is to be congratulated not only upon the manner in which it has provided for the supply of operators, but also upon this generous offer, which is certain to evoke a hearty response, and will result in disseminating a practical working knowledge of wireless telegraphy over a wide area—besides adding one more to the many "badges" which reward the industry of the Boy Scout who is no slacker.

SOME DIFFICULTIES WITH TRAMCAR MOTORS.

The majority of troubles which are found on traction motors can be traced to comparatively simple causes. In one case, for example, it was noticed that a motor was exceptionally hot when the car was run, and at first it was thought that there was some defect in the design or construction of the motor, to which the attention of the manufacturers would have to be drawn. Examination, however, showed that both of the bolts on one of the field magnets in the top half of the motor case had slacked off, with the result that the magnet had been dropped slightly in position, and its pole face was rubbing against the armature. The field-magnet bolts which had been used were of the round-headed type, and the only inference which could be come to was that when the motor had been fitted, and the nuts had apparently been tightened, the bolts had been turned round with the nuts, with the result that they were not tightened up properly. It was, of course, a mistake to use round-headed bolts of this description for such a purpose, as it is difficult to prevent the bolt itself from turning, and all that can be done with this class of field-magnet bolt is to exercise very great care to see that the bolt does not turn, and to use a good make of lock washer. Wherever possible, however, square-headed bolts should be used.



The faces marked x should meet when bolted up at b.

Fig. 1.

Another cause of failure was discovered some little time after a car motor had been overhauled and fitted with new bearing bushes. After a short run in service, it was found that a bearing cap was broken, and that the armature had

dropped on the field magnets, and the car was taken back to the depôt for inspection. It was then seen that the new bearing bushes were slightly larger in diameter than was requisite, and consequently when the bearing cap was bolted up, the lug face did not bear against the motor face. The position will be understood by reference to the illustration in fig. 1. If the bearing bush had been of the right external diameter, the faces of the bearing-cap lugs would have met the corresponding surfaces provided on the motor case, but the result of a gap left in this way was that the lugs of the cap, which was a casting, were in tension, and when they were subjected to the strain of the motor and the vibration on the road, they sheared, as shown in the sketch. Thus a considerable amount of trouble was caused by what was apparently an altogether unimportant detail, but the attention of the turner was drawn to the defect in order to secure the system from further trouble due to this cause.

Another difficulty which may be mentioned was of such a nature that at first the superintendent was thrown upon the wrong scent altogether, and it was not until a considerable amount of investigation had taken place that the true cause of the trouble was identified. It was noted on inspecting a car after returning from service that the motor case on the car had been rubbing slightly on the stone setts between the track. Usually this occurs when there are some high setts somewhere along the track, or else when the wheel tires are being run at less than the minimum thickness. It was found that although the tires were worn, they were still larger than the minimum diameter. An investigation of the track throughout the whole route, where the car had been in service, showed that it was in quite good condition, without any stone setts projecting unduly from the surface of the permanent way. Investigation was, therefore, thrown back on the car itself, and after a considerable amount of search it was discovered that there were no rubber shock absorbers under the axle-box springs, and, partly due to this cause, the springs themselves had closed up for about ½ in. These shock absorbers consisted of rubber washers about 1 in. thick when they were not under compression, and the combined effect of their absence, together with the closing-up of the springs and the wear on the tires which had taken place, had reduced the motor clearance to such an extent that the motor casing had rubbed on the crown setts of the track. The fitting of shock absorbers under the axle-box springs, together with the introduction of new springs of standard length, gave sufficient room to the motors to enable the full mileage to be got out of the tires before they had to be renewed.

In another case a hot armature bearing occurred on a car motor which had just been overhauled, and when the bearing was taken down in order to discover the cause of the trouble, it was found that this bearing had not received any lubrication, and it therefore fired and seized. The bearing bush had been fitted with a slot through which a felt pad pressed on the journal, and supplied the lubricant, and on the bearing cap was provision for a dowel pin fitting into a hole in the bush in order to ensure that the lubricating slot was in the proper position. In this particular case, however, the dowel pin had come out during the overhaul of the motor, and, unfortunately, when the motor was put into position again, the absence of the dowel pin was not noticed. Hence when the car was running in service the bearing bush turned owing to the absence of the pin, and in turning displaced the pad, interrupting the supply of lubricant and causing the hot bearing.

These few instances are typical of a good many others which might be narrated, showing the importance of the proper upkeep and repair of a tramway system.

Gateshead Tramways.—The Gateshead and District Electric Tramways Co. is just starting a service of motor-buses as adjuncts to the tramways. The first section will be between Low Fell and Chester-le-Street, so that passengers will be able to travel from Gateshead by car to Low Fell, and thence by 'bus to Chester-le-Street, a distance of 8½ miles, for a 6d. fare. Another route will link up Heworth tramway terminus with the Usworth and Washington district. The chassis of the buses have been built by Messrs. Straker & Squire, and the bodies by the Immisch Co.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Notice of Opening of Roads.

I understand that under Clause 61 of the new Bill promoted by the Metropolitan Water Board, the promoters are seeking to obtain powers to force any local authority or gas, electric light or water company to give them three days' notice before opening up any roads in their area.

The Battersea Borough Council are endeavouring to get the reference to local authorities omitted, but I have yet to hear that anyone is moving on behalf of the companies.

The electric light companies are already sufficiently burdened in this respect, having to give notice to the local authority and the gas company. One would not mind so much if the local authorities and the gas companies were compelled to return the compliment, but they are not.

Is it not worth while even now for the companies to follow the example of the Battersea Borough Council and endeavour to get the reference to themselves omitted, or failing this, to get a corresponding obligation imposed upon the Water Board?

M. Farrer.

Twickenham Electricity Supply,
March 18th, 1913.

Regulations Regarding Celluloid.

There are points in the London County Council General Powers Bill and the City of London Celluloid Regulations Bill which should receive the attention of traders, on account of the probable effects of them if they are allowed to be passed. If these Bills which propose to deal with the London area are passed, no doubt similar legislation will be promoted all over the country, and it is therefore imperative that Members of Parliament should be approached by traders to call their attention to the effect such legislation would have in handicapping shopkeepers and warehousemen, who are already suffering from heavy taxation, and some of whom are hardly able to make a reasonable livelihood, and if they were to be subjected to further harassing regulations would have to close down.

Neither the London County Council nor the City of London Corporation have the slightest case for asking for regulations for the storage of celluloid. The fact is that the fire at Moor Lane, where they were manufacturing articles out of celluloid, has caused the County Council and the Corporation to promote hasty and immature Bills. The manipulation of celluloid is one thing, and the storage is another, and we must fight to the best of our ability to have the storage clauses cut out of the Bill altogether.

The Bills ask Parliament to grant practically unlimited powers to members of these two corporate bodies, most of whom have no knowledge of the trade, and who may, with the best intentions, so use their powers as to destroy the trade without any necessity at all.

The regulations are left entirely to the discretion of the County Council or the City Corporation, and on behalf of the trade I most strongly object to its being left to any such body to create restrictions which are wholly unnecessary, the nature of which is not foreshadowed in any way, and which, if unreasonably made, must seriously hamper a very important industry and business.

Traders are at present suffering from a sufficiency, to say the least, of inspection and inspectors, and from the dead charges created by recent legislation; now a new attempt at creating a fresh army of inspectors is found in these two Bills, and it is both desirable and necessary for the trade to oppose them.

I have been examining the reports for the last seven years of the Chief of the London Fire Brigade, and find that out of a total of 24,726 fires, only 10 were in any way affected by celluloid, and in almost every case it was in connection with celluloid film. Large quantities of celluloid have been sold and stored in shops and warehouses for the last 35 years, and the record is singularly clean. For every one death due to celluloid, according to the firemaster's

reports above referred to, there were 90 recorded due to children playing with matches, beside a host due to children playing with fire; yet our County Council and City Corporation do not take any notice of that, but from sentimental reasons they promote Bills of which the preamble, so far as it relates to the matters aforesaid, is unfounded and incorrect, and incapable of proof.

If any traders want any further particulars, I shall be only too happy to supply them.

The British Xylonite Co., Ltd.
Thos. R. Brooke, *Commercial Manager.*

Hale End, London, *March 19th*, 1913.

[We refer to this matter in a leaderette.—Eds. Elec. Rev.]

Canvassing Councillors.

With reference to the recent meeting of the Bermondsey Borough Council, at which our tender for 170 Metroflam lamps was formally accepted, our attention has been drawn to a complaint made by one of the members relative to councillors being canvassed at their homes by the representatives of competing arc-lamp makers.

We wish to make it quite clear that the remarks in question have no reference to our firm, as we have never approached any of the members of the Council in connection with this contract, all our communications with the Council being made through the borough electrical engineer.

Johnson & Phillips, Ltd.,
St. J. Sheppard, *Director.*

Charlton, *March 18th*, 1913.

Morse Signalling on Submarine Cables.

Referring to my letter and cable slip of March 7th, 1913, may I beg sufficient space in your valuable paper to inform Mr. E. Raymond-Barker, and others interested, that I did most successfully, and without any difficulty whatsoever, convert these inverse currents into Morse dots and dashes in the manner suggested, and they might have been relayed with ease.

P. O'Neil.

London, E.C., *March 18th*, 1913.

The "Load-Factor" Question.

In reply to "Consumer," for the purposes of determining a charge for energy, the time element may be the total number of hours during which current is available, viz., 8,760 for an ordinary year for most public supplies.

Few figures can be so misleading as that of load-factor.

It is quite easy to show that a poor load-factor can be profitably supplied at a very low rate; it does not always follow that a high load-factor can be supplied at a low rate.

A domestic refrigerating plant will probably have a very low load-factor, but it can be quoted at a low price because it will only be used in the summer time, and only a very small percentage of the energy it uses will be delivered at times of any peak load.

The load-factor of a barber's brush is not high, but it is quite desirable business on account of its abnormal diversity. Again, cooking offers an "all-the-year-round" load with summer maximum, and can be quoted at lower rates than heating, if that is considered desirable. This is, perhaps, the best case for the load factor.

A case came under my notice a while ago, in which one customer was taking two classes of load of about equal demand, from 8 a.m. to midnight all the year round. The normal load factor was really over 30 per cent., but for a few weeks in the winter time the two loads overlap for an hour or a trifle more. Academically, this overlapping halves the load factor, because it doubles the maximum demand. It is one of those many cases in which a load factor is of small commercial significance in deciding the price to be quoted.

Probably no system of charging for all loads will ever be so sound and equitable as by two rates over stated periods—unless Dr. Ferranti's dream materialises, when, I suppose, load curves will be like a saw edge, and units fetch about £1 per 1,000. The cost of the meters militates against the general adoption of this scheme, but having determined what must be the "guarded" or high-price period, it will not be difficult to determine approximately what percentage of the total units delivered to any customer will be generated within that "guarded period." For this percentage, the "average price obtained" should at least be charged, and for the remainder a small margin above "running costs" as separated from "standing charges."

The price charged inside the "guarded period" can gradually advance as the percentage increasingly preponderates up to a maximum price per unit. From these figures a flat rate can be quoted.

Reginald W. Klitz,
Chief Assistant Electrical Engineer.

Wimbledon Electricity Supply,
March 20th, 1913.

The Electro-Harmonic Society.

I think if the letter in your issue of the 21st were allowed to pass without comment, a very wrong impression would get abroad. I can personally assure you that a very large number indeed of the members of the Electro-Harmonic Society have a strong objection to the practice of not smoking on Ladies' Nights; this feeling is not confined to the members, but is shared by the ladies as well. I think that no one could have any objection to smoking being permitted, say, after the interval. Your correspondent's remarks about drinkers seem to be quite out of place.

Referring to your foot-note to the letter in your issue of the 7th inst., the fact that you have not heard any complaints from *Members* of the Society must be due to the fact that you are so busy attending to the artistes and the programme. The subject is often broached in the room, and I can give you a lengthy list of people who would like to see the present practice changed.

If the Committee do not wish to make the alteration, they might at least remove temptation from us in the shape of matches and fairy lamps, which are always placed on the tables!

F. R. C. Rouse.

London, N.W., *March 20th*, 1913.

[It is not for us to dictate to the Committee. The "Ladies' Nights" are not "Bohemian" Concerts, and if members and ladies find difficulty in refraining from indulgence in the fragrant weed, we can only suggest that the temptation be removed. We may add that our meeting with members is not confined to the King's Hall.—Eds. Elec. Rev.]

Small Electrical Undertakings.

In regard to your North Yorks. note on p. 471, the Dales are much further forward than even your notice would indicate. Some five years ago, the Askrigg works were started to supply Askrigg, a village of 400 inhabitants; the following year the Reeth and Hawes schemes were undertaken, with populations of 400 and 800 respectively. Grassington was finished just after Askrigg; two years ago, the Aysgarth scheme was undertaken, while Middleham was similarly provided for three years ago.

Bainbridge, a little village of less than 250 inhabitants, has its own plant supplying at 6d. per unit, and looks like paying. I may say the schemes vary from 500 volts A.C. to 50 volts D.C., and are worked from ancient water wheels, turbines and up-to-date producer gas plants.

Ernest Burton,

Askrigg, *March 20th*, 1913.

Heavy-Service Lampholders and Adapters.

Re "Sales Superintendent's" and "Engineer's" remarks about lampholders, this lampholder is badly required here, and, so far, the manufacturers have nothing that will stand 5 amperes for any length of time without

breaking down. The old form of lampholder with the springs sweated or brazed to the pins at the top, and the base of contact to the leads, would carry 5 amperes without injury. The lampholders of to-day are very inferior in this particular. I am sure that any suppliers of a suitable 5-ampere capacity B.C. lampholder would get a huge demand not only here, but all over the country, owing to the increasing system of charging by contract, &c., and registering the domestic light and power consumption through only one meter.

C. J. Stonier,
Sales Superintendent.

Dundee Electricity Supply,
March 30th, 1913.

LEGAL.

County of London Electric Supply Co., Ltd., *v.* J. Salomon & Co

Mr. Justice Bankes on Tuesday, March 18th, in the King's Bench Division, had before him for further consideration the case in which the plaintiffs sued defendants, leather dealers, of Weston Street, Bermondsey, to recover £1,880 5s. 1d., for electricity supplied to the defendants' factory at Mina Road, Old Kent Road, S.E., from June, 1908, to November, 1911. The plaintiffs' case was that through the reading of the final figure of the total shown on the meter dial as a decimal instead of a unit, the defendants had, in error, only been charged one-tenth of the proper amount. The matter was reported in our issue of March 7th. The jury had found in answer to questions left to them, that the plaintiffs at the end of each quarter by the quarterly accounts rendered, represented to the defendants that the quantity of power consumed was materially less than the amount actually consumed, but that the plaintiffs did not intend that the defendants should act upon such representations, that the defendants acted upon such representations, that the meter supplied by the plaintiffs was a suitable one, that the plaintiffs' servants were negligent in reading the meter, that the plaintiffs kept the meter in proper order for correctly registering the value of the supply, and that the defendants by reasonable care could have ascertained that they were using much more power than they were being charged for.

Mr. Atkin, K.C., counsel for the plaintiffs, said that his Lordship would not be further troubled with the case. The plaintiffs abated £150 off the claim, and there would be judgment for the plaintiffs for £1,730 5s. 6d., with costs. Certain money in Court would be paid out in part satisfaction.

Mr. Justice Bankes, in assenting, said: I am very glad to hear that.

British Economical Lamp Co., Ltd., *v.* The Empire, Mile End, Ltd., and A. Bernstein.

On March 19th, the reserved judgment was delivered of the King's Bench Divisional Court, composed of Justices A. T. Lawrence and Lush, in this case, which had been argued before their Lordships on February 14th. The plaintiff company appealed against a decision by Sir Forrest Fulton, the Recorder, at the Mayor's Court last year. The plaintiff company had proceeded to recover certain lamps at the theatre, or their value, and damages for their alleged detention. They had been let to the theatre tenants, and the landlord had entered on account of the non-payment of the rent. The plaintiffs claimed the lamps, but the Recorder held that the bulbs were fixtures, and had entered judgment for the defendant, the lessor.

For the appellant company, Mr. Geo. Wallace, K.C., had argued that the glass bulbs were not part of the house, and Mr. Rankin had submitted an argument in support of the Recorder's decision.

The judgment of Mr. Justice Lawrence (read by Mr. Justice Lush) was to the effect that the appeal must be dismissed, with costs. The action was brought to recover the electric lamps, or their value, and damages for their detention. The owners of the theatre re-entered for non-payment of the rent, and had been in possession a month or more before the plaintiffs made their claim. The lamps were affixed to the brackets by the bayonet attachment in common use for the purpose. The plaintiff company let the lamps out on hire to the late tenants of the theatre, and at the Mayor's Court the Recorder had held that the lamps were trade fixtures, and had given judgment for the defendant. The plaintiffs' appeal was against this decision, and they had to consider if the plaintiffs had shown a cause of action. In his opinion they had not done so. They claimed the right to enter the theatre and remove the lamps. The plaintiffs had their remedy against the person to whom they let the lamps. He thought the case did not involve any examination of the various decisions as to fixtures. In his judgment the plaintiffs failed, because they had shown no cause of action. The lamps were affixed to the brackets, and he knew of no duty on the part of the defendant to disconnect them and return them to the plaintiff company. He thought, therefore, the appeal must be dismissed with costs.

Mr. Justice Lush, in his judgment, pointed out that the defendant was the lessor of the theatre, and he had re-entered for non-payment of the rent. The Recorder had held that the lamps were trade fixtures, and had given judgment against the plaintiffs, but he (Mr. Justice Lush) did not agree with that view. He agreed, however, that the plaintiffs had shown no cause of action, and he agreed that the appeal must be dismissed with costs.

The appeal was accordingly dismissed with costs. Leave was granted appellants to appeal further.

Mr. Geo. Wallace, K.C., smilingly observed that "the decision they really wanted they had not got."

Battersea Borough Council *v.* The County of London Electric Supply Co., Ltd.

In the Chancery Division, on Tuesday, this case was mentioned on a motion by the plaintiffs for an interlocutory injunction restraining the defendant company from breaking up the Council's streets in order to lay their mains.

Mr. Hughes, K.C. (for the plaintiffs), explained that the action raised a very important question upon a point of law under the London Electric Supply Act of 1908, but it was quite impossible for him to proceed with his motion that day, as the defendant company had just filed an affidavit, which he had not had an opportunity of considering. Counsel asked his Lordship to fix a convenient day early next term, as the matter was very urgent.

Sir Alfred Cripps, K.C., M.P. (for the defendant company), agreed that the question was one of law and that it was important, but said that his view was that it had already been decided in his favour in a case tried by Mr. Justice Parker (now Lord Parker). It was a case in which the defendant company had to give certain notices, which had been done. If those notices were objected to, they had, in the company's view, to go before the Board of Trade. The company were quite willing to go before the Board of Trade, admitting that they were unable to proceed without the consent of that body. They refused, however, to give any undertaking pending the hearing of this motion.

Mr. Hughes: They claim to break up our streets and lay their mains through our streets. Whether they are right or wrong, it is an important matter for the Council.

His Lordship fixed Monday, April 7th, for the hearing of the motion, subject to any case part-heard.

Hall, Bayliss & Co., Ltd., *v.* Boddam.

This action, heard at Clerkenwell County Court last week, was a claim by plaintiffs, a firm of manufacturers, against Col. Boddam, an electrical specialist, of Old Jewry, E.C., for £6 1s. 9d., as the half cost, as agreed, of making an electric water heater, carrying out tests, and advising. Defendant counterclaimed for £20. Plaintiffs, he set up, verbally agreed to make an electric water heater according to plans and specification to the value of £20, in return for 21 days' option to purchase the patent. Defendant complained that the heater was not of proper material or manufacture. Plaintiffs, he alleged, did not carry out their contract, and he claimed as damages the £20 agreed to be paid for the option.

At the close of the hearing, his Honour held that plaintiffs were entitled to recover on the claim for £5. 16s. 6d. With regard to the counterclaim, that was a whole misconception. One man could not say that another one must exercise an option. That was not the meaning of giving an option. The person to whom it was given had the right to say, "I am not going to exercise it," and because of his refusal the other side could not come upon him for damage unless the man promised to pay damages in the event of failure to exercise the option. Therefore, the judgment must be for plaintiffs on the claim and counterclaim.

Postmaster-General *v.* Dublin Corporation.

In the Chancery Division, on 17th inst., in the matter of the above action, it was stated that difficulties had arisen between the parties as to the carrying out of certain telephone works which were then in course of execution. After hearing the argument, the Master of the Rolls directed an injunction to issue until further order, restraining the Corporation from interfering with, or in any way obstructing, the plaintiff in the laying of an underground telephone line and the provision of manholes along Baggot Street, Merrion Street, and Nassau Street, as shown by the plan furnished to the defendants by the plaintiff, the plaintiff undertaking to abide by any order of the Court. The question of costs was reserved.

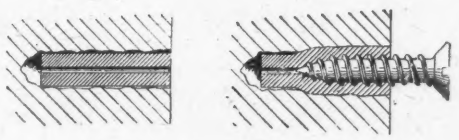
Burnham (Somerset).—With reference to the electric lighting scheme proposed by Dr. J. A. Purves, of Exeter, the U.D.C. has asked him, if he saw no real prospect of being able to form a company to carry out the scheme, whether he would agree to stand aside so that the Council could negotiate with others. Dr. Purves had previously written to the Council promising that Burnham should be attended to now that a company had been floated, but as the time in which the company had to be registered had really expired, he asked the Council to grant another four months in which to enable him to get the company registered. At the Council meeting it was explained that Dr. Purves had until August 8th to complete the matter.

BUSINESS NOTES.

Catalogues and Lists.—The British Aluminium Co., 109, Queen Victoria Street, London, E.C.—Three new illustrated circulars, one relating to aluminium collector bows, a second concerning aluminium light railway feeders, and the third, sundry aluminium fittings.

Messrs. Drennan, Glover & Cooper, Corn Exchange Buildings, Hanging Ditch, Manchester.—Catalogue "J," of 56 pages, containing a large amount of tabulated data and prices, relating to their resistance materials, including "Nichrome" resistance wire, which is widely used for domestic electric heating devices, and "Nichrome II," which is the successful outcome of several years' work to produce a wire which can be run permanently at 2,000° F. Owing to its slightly higher cost, the restriction of its use at present to more severe conditions, such as laboratory furnaces, soldering irons, grills, hot-plates, &c., is suggested. The other materials included in the list are Climax nickel, Advance, Therlo, Yankee silver, German silver, and ferro-nickel.

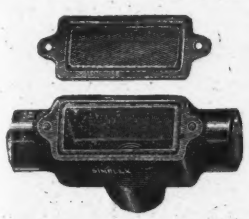
Messrs. W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, London, E.C.—Circular No. 76 giving particulars and prices of a new patent plug for use with the Henley wiring system, for fixing their patent "Link" clips, saddles and protective covering to plaster, brick, marble, slate, stone, &c. It is believed that the plug will fill a long-felt want for many purposes.



Henley's New Patent Plug.

The hole made for the plug is only a little larger in diameter than the screw that fits it. Satisfactory tests made at the works showing the strength of pull required to remove the plugs from plaster and brick respectively, are published in the list.

Messrs. Simplex Conduits, Ltd., London and Birmingham.—1913 edition of their pocket catalogue (84 pp.) of conduits and conduit accessories, distribution boards and watertight fittings. Very compactly arranged, and with numerous illustrations and price information, the present edition contains practically the whole of the matter covered by sections "T," "D," "U" and "M" of their general catalogue in a condensed form, and bound in handy size for contractors' convenience on the job. One or two new designs of conduit fittings have been added. These include back outlet bends and tees, which are intended for screwed conduit installations, and have heavy cast covers, to serve as a drawing point where a branch is taken off at right angles to the main run of conduit.



Simplex Short-Arm Tee.

Messrs. Cammell Laird & Co., Ltd., Cyclops Steel and Iron Works, Sheffield.—"Catalogue of Tool Steel" (about 90 pages, bound). Particulars of their high-speed steels, mining tool steels, special steel for coal-cutting machines, shear steels, water-hardening steel, non-tempering steel, nickel and automobile steels, sections of tool and spring steel, and other productions, are included, and a number of pages give weights, equations, gauges, and so on, in tabular form.

The Century Electric Co., St. Louis, U.S.A.—16-page illustrated pamphlet respecting "Invincible" split phase motors.

The Brush Electrical Engineering Co., Ltd., Loughborough.—40-page book of pictures showing their various types of electric cars for tramway and light railway service, their designs for colonial and foreign cities predominating. A number of pages are devoted to Peckham truck illustrations.

Shopping Week.—At the Ashton-under-Lyne shopping festival last week, Messrs. Eaton & Co., of Old Street, were awarded a 2nd prize for their show of electrical goods.

Belgium.—La Société des Ateliers Electrochemiques is the name of a new concern which has just been formed in Brussels with a capital of £3,000.

Book Notices.—"*Journal* of the Western Society of Engineers." Vol. XVIII, No. 1. January, 1913. Chicago: The Society. Price 50 cents.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXII, No. 3. March, 1913. New York: The Institute. Price $1.00.

"*Journal* of the American Institute of Architects." Vol. I, No. 3. March, 1913. Washington: The Institute. Price 50 cents.

"La Fixation des Unités par Voie Legislative." By R. de Baillehache. 1913. Paris: A. Colin.

Tale of a Lamp.—We have received a story regarding a 16-watt, 250-volt Osram drawn-wire lamp which inadvertently found its way to an ashbin, from which it was taken in the usual way to the refuse cart, and from the latter, also in the usual way, to the refuse heap at a destructor worked by an electric supply company, in the neighbourhood of Blackpool. But it survived, once more in the usual way, being rescued, clothed in its carton, by a workman, in a nick of time almost like a "brand from the burning," though it hadn't really reached the fire. Of course, after all that has gone before, it is surprising that the said workman was surprised to find it intact—everybody ought to have known what would happen! However, the end of the story is that the rescued lamp is burning "happily for ever afterwards," shall we say, in the house of the charge engineer.

Trade Announcements.—It is announced that the business lately carried on by Messrs. T. E. Smith & Co., Ltd., Keighley, is being continued by Mr. J. H. Smith, under the style of the Smith Electrical Co., Ltd., at 7, Cavendish Street, Keighley.

The Electricity Supply Co. for Spain, Ltd., have removed to Dunster House, Mincing Lane and 12, Mark Lane, E.C.

France.—The *Financial News* publishes news from Brussels to the effect that a Franco-Belgian syndicate, composed of the Ateliers de Constructions Electriques du Nord et de l'Est, the Banque de Bruxelles and the Banque Empain, intend to establish new iron smelting works near Dunkirk.

C.T.S. Rubber Gloves.—Mr. R. Nelson, Electrical Inspector of Mines, was recently reported to have said at an inquest that he did not like to see insulating gloves in use, presumably because when these have become worn or damaged, they become more dangerous than no gloves at all. To meet this difficulty the St. Helens Cable and Rubber Co., Ltd., of Warrington, applied a thin sheathing of leather to the face of their rubber gloves, which protected the rubber, but was not wholly satisfactory; the company, therefore, have made a further improvement, by devising a method of covering the gloves on the palm and fingers with their patent cab-tire sheathing, already well known in connection with their C.T.S. cables. We understand that this combination, which has been provisionally protected, appears to fulfil all the requirements of high insulation, long wearing power, flexibility and convenience in use.

Bankruptcy Proceedings. — Charles Spencer Northcote, electrical engineer, 67, Stanthorpe Road, Streatham, London.—The adjourned public examination of the above-named debtor was held at the Court House, Wandsworth, last week. The Official Receiver said he had no further questions to ask, and debtor, having read the shorthand notes of his previous examination, and answered the formal questions of the Registrar, was allowed to pass, the examination being concluded.

Francis Hastings Medhurst (deceased), engineer, Victoria Street, S.W.—First and final dividend of $2\frac{1}{16}$d. in the £, payable April 8th, at the offices of Elles, Salaman & Co., 1 and 2, Bucklersbury, E.C.

Liquidation.—Dolter Electric Traction, Ltd.—A meeting is called for April 23rd at Austin Friars House, Austin Friars, E.C., to hear an account of the winding up from the liquidator, Mr. W. S. Ogle.

Meter Approved.—The Board of Trade has approved of the Ferranti A.C. meter type C (single-phase two wire) deposited by Messrs. Ferranti, Ltd., in November, 1911.

LIGHTING and POWER NOTES.

Algeria.—A central electric lighting station is to be established in the little town of Gurgotville.

Argentina.—The Hydro-Electric Co., of Tucuman, has made an offer to the municipality of that city to undertake the street illumination at a figure showing a reduction of 12 per cent. on the actual amount now paid to the Cia. Electrica del Norte. If the proposal of the Hydro-Electric Co. is accepted it would mean a reduction in the public lighting bill of $1.200 a month.

The province of Buenos Aires Electricity Co. is arranging to give a day service in Azul. This company is erecting a station at Ramos Mejia, the building is now nearly finished, and the machinery will shortly arrive. It is also extending to the suburb of Caseros, where a sub-station is to be erected, current being taken in bulk from the Compania Alemana; the land for this station has already been purchased and plans prepared. In Villa Ballester a new sub-station is being built which will be supplied from the San Martin station.—*Review of the River Plate.*

Australia.—According to the *Australian Mining Standard*, some little time ago Mr. Forbes Mackay, the Sydney city electrical engineer, brought forward a proposal to construct an underground storage battery, which, with auxiliary plant, cables, &c., was estimated to cost £52,500. This battery was to provide for the expected load of 1914. Eleven tenders were received for the work, none of which complied with the general conditions specified, and the lowest entailed an expenditure of £63,000. The increased cost was due to the general increase in prices since the proposal was first considered, and the engineer

recommended, and the Council agreed, to drop the proposal for the present. Additional power is required, however, and tenders are to be invited for a 5,000-KW. turbo-generator.

Barnes.—The electrical engineer has been instructed to report whether special arrangements could be made with shopkeepers who use arc lamps for outside shop window lighting; and also upon the question of reducing the charges to consumers and for public lighting. The £1,000 standing to the credit of the undertaking is to be put aside as reserve.

Bromley (Kent).—The Electricity Co. has submitted to the T.C. terms for public lighting, viz., 1,009 single 60-watt lights at £3 5s. 6d. each per annum, and 46 240-watt lamps at £6 each, a ten years' contract being asked for owing to the cost of converting the lamps.

Bury.—At a meeting of the Electricity Committee, the electrical engineer (Mr. S. J. Watson) reported that he had been approached by representatives of the Peel Spinning and Manufacturing Co., with regard to a supply of electricity, which the company would require for power purposes when it had carried out the contemplated extensions to its mill. The Committee confirmed the terms offered by the engineer.

Canada.—The Calgary Power Co., owing to the rapid extension of the city, has decided to develop another of its water powers at Kanamaskis Falls, 2 miles above the present Horse Shoe Falls plant, at a cost estimated to be $1,000,000.

The Western Canada Power Co., of British Columbia, will shortly have 100,000 H.P. developed on the Stave River. The second installation of the company's plant is near completion, and a large contract for a minimum of 12,000, and a maximum of 40,000 H.P., has been entered into with the British Columbia Electric Railway Co. from this second installation.

It is stated that fresh proposals are being made for utilising the tidal movement in the Bay of Fundy, between New Brunswick and Nova Scotia, in the generation of electricity for supply in Eastern Canada. Our correspondent says a site has been chosen for the project, and a reservoir is to be constructed between an island and the mainland, where from 50 to 70 ft. tides are found.

The Hon. Adam Beck, of hydro-electric power fame, is said to be investigating the possibilities of the H.T. direct-current system for Canadian transmission work.

Caton.—The ratepayers have decided to form a company to install electric light. For many years the village, which is practically a suburb of Lancaster, has been supplied by gas from the works of Story Bros., Ltd., Queen's Mill. They have arranged to substitute electric power for gas, and left the villagers to their own resources. Most of the capital required has already been subscribed, a gratifying feature being the interest taken in the scheme by the inhabitants.

Chester.—The Electricity Committee has decided to recommend the T.C. to sanction an extension of the electricity works as suggested by the electrical engineer, at a cost of £11,550.

Clacton-on-Sea.—The U.D.C. has applied to the L.G.B. for a loan of £6,000 for extensions to plant and buildings at the electricity works.

Doncaster.—The Electricity and Tramways Committee has decided to recommend an extension of the electricity works, at an estimated cost of £12,500.

Dover.—The Electricity Committee has had under consideration a report from the electrical engineer on the relative costs of automatic and hand control of the street lamps. He estimates that when the present conversion is completed, the average cost for the next three years for controlling and maintaining the lamps, exclusive of renewals, will amount to £290 per annum, also that if time switches were fitted to all the posts excepting those on the route of the lamps controlled from the works, and were incandescent lamps substituted for the arcs, the cost would only amount to £77 per annum: and if £13 were allowed for expenditure on repairs to the clocks, there would be a clear saving of £200 per annum. The cost of 325 time switches (the actual number required to meet present requirements) would amount to £528, and it is suggested that the cost should be spread over three years by means of a suspense account, although if only two years were allowed, the ultimate saving would seem to justify the increased cost of £64 per annum for the next two years. The Committee has approved and adopted the report, and has decided to spread payment over a period of three years as suggested.

Duffield (near Derby).—At the annual meeting of the parishioners a resolution was passed approving of the proposals of the Corporation of Derby to extend its electric lighting and power system to Duffield, provided that the mains are laid underground where so required by the Parish Council.

Dufftown (Banff.).—At a meeting of the T.C. it was reported that Mr. Barker, Nairn, had been engaged to give a report on a lighting scheme for the burgh with coal gas, and Mr. M'Leod, Clyde Valley Electric Power Co., Glasgow, to give a report on an electric scheme, the fee of the former being 8 guineas inclusive, and that of the latter £20 and expenses.

Dungarvan.—The B. of T. has informed the Urban Council that if it wishes to obtain powers for the electric lighting of the town, it will have to consider applying for a provisional order, as the Board has no power to grant licences for this purpose.

Ealing.—The electrical engineer has been authorised to purchase 50 electric heating irons, which will be let out on hire to consumers at a charge of 1s. per quarter, additional to the charge for current consumed.

Eton.—A statement to the B. of G. regarding the adoption of electricity for lighting and cooking, instead of gas, at the workhouse, showed that for the previous year gas for lighting and cooking, with rent of stoves, repairs to mantles, burners, &c., and 20½ tons of coal, cost £228. During the past year the cost of electricity, rent of meters, lamp renewals, part cost of new range and of installation, and 10¼ tons of coal, amounted to £78, a saving of £150. The master of the workhouse testified to the improved conditions of lighting, atmosphere, &c, since the introduction of electricity.

Glasgow.—The date has been fixed for the exhibition of appliances for power, heating, cooking and lighting under the auspices of the Glasgow Corporation, at from October 23rd to November 15th. It is expected that there will be a large entry by manufacturers and contractors.

Gloucester.—The Council has adopted a scheme recommended by the electrical engineer, under which private consumers will have the option of taking a supply of electricity at the ordinary rates, or for an annual payment equal to 12½ per cent. upon the rateable value of their premises, and 1d. per unit for all electricity consumed. The tender of Messrs. Ruscoe, of Hyde, amounting to £195, was accepted for supplying and fixing mechanical stokers for two of the boilers at the electricity works.

Greenock.—At the annual meeting of the T.C. on the 18th inst., Treasurer Williamson announced that the agreement with the Port Glasgow power users was now completed. Shipbuilders and engineers had felt some difficulty with the 30 years' undertaking, but the speaker gave the assurance that no better terms could be given at a later stage by Greenock Corporation for power. It was reported that for the last four weeks the supply of electricity showed an increase of 116,968 units over the same period of 1912—an increase of nearly 11 per cent.

The B. of T. has sanctioned the borrowing of a further sum of £30,000 by the Corporation for the electricity department, to cover expenditure to be incurred in connection with the extension to Port Glasgow.

Grimsby.—In connection with the proposed purchase of turbine plant for the electricity department, it has been decided to revise the application to the L.G.B. from £8,650 to £9,300, in order to carry out certain additional work.

Ham (Surrey).—At a meeting of the U.D.C. on March 20th, the clerk reported that he had prepared an agreement with the Twickenham and Teddington Electricity Supply Co. for supplying electricity to the district, but owing to trouble with the B. of T. nothing definite had been decided.

Harrogate.—The C.C. has decided to have the electric light installed at the police court premises, and the T.C. has decided to contribute £20 towards the cost.

Haydock.—The B. of T. has revoked the 1905 electric light order.

Hayward's Heath.—The application of the Mid-Sussex Electric Light and Power Co. for a prov. order for electric supply, formed the subject of a B. of T. inquiry last week. It was stated that the company intended to supply Hayward's Heath, Lindfield and the urban part of Cuckfield, and the only opposition was as to the site of the generating station, which had been acquired from the U.D.C., and which was 200 yds. from the nearest house.

Heysham.—An application was made to the Morecambe T.C. last week to apply for powers to supply electricity in the Heysham Urban Council district, which immediately adjoins the west end of Morecambe. The leading property owners and occupiers signed the request, which was heartily received by the Morecambe Corporation.

Hindley.—The U.D.C. has approved a draft agreement with the Lancs. Electric Power Co., and has forwarded it to the B. of T. for its approval before completing it.

Hornsey.—The income of the electricity undertaking for the year ending March, 1914, is put at £23,350, as against an estimated expenditure of £22,629. In the discussion which occurred upon this estimate, Councillor Double urged that, as there was a balance of £5,000 on the undertaking, and a sum of £4,000 was sufficient for working capital, a reduction in the price of current supplied should be made to consumers. Application is to be made to the L.G.B. for sanction to borrow £3,000 for services.

Hoylake and West Kirby.—At a meeting of the U.D.C., the chairman of the Finance Committee presented the annual financial statement, which showed that the electricity undertaking had done very well, the approximate profit for the year being about £450. It was stated that the Committee had under consideration a further extension of the machinery in order to cope with any further development the district might make.

India.—The Madras Corporation has proposed to raise a loan for various improvements, including electric lighting. The electric lighting will occasion expenditure of about 10 lakhs of rupees, but of this sum only 3 lakhs have been budgeted for the financial year of 1913-14. The Corporation is to be congratulated on having determined on the electric lighting of the city. Private

citizens of all classes have provided themselves with this form of illuminant; the most insignificant bazaars are now to be seen lit with electricity, and it is about time that the Madras streets followed the example. When the electric lighting is an accomplished fact, or even before that time, the levying of the maximum lighting tax will doubtless become a necessity and will not be grudged.

It is now confidently expected that the Simla hydro-electric scheme—the main details of which have been given in these notes, will be ready for opening early in May next.

Tata Scheme.—Our contemporary, *Indian Industries and Power*, recently reviewed the position of the constructional work on the Tata hydro-electric scheme. The initial scheme provided for some 30,000 H.P., but the completion of the three reservoirs, Lonavla, Walhwan, and Sherwata will enable some 60,000 H.P. to be supplied. The Sherwata dam is an extension of the original scheme and has just been commenced. Work is being actively carried on in connection with the dams, power house, pipe line and transmissions; it is expected that the hydro-electric plant will be in operation in a year's time, as the superstructure and machinery foundations of both power house and receiving station are under construction.

At the Bombay end, preparations are being made by the mills to utilise the power, and nearly all the motors and transformers required are said to be on order, while half the underground supply cables on the island of Bombay have been laid. Contracts have been entered into to supply 30 cotton mills and three flour mills, the smallest installation being of 250 H.P.

Inverness.—The North of Scotland E.L. and P. Co. has secured its first municipal lighting contract; the Market Hall is to be electrically lighted, the cost being given as 7d. per hour as against 9d. per hour charged for gas at present.

Keighley.—The T.C. last week considered the proposed arrangement for supplying the Bingley Urban Council with electricity in bulk for a term of 10 years certain, and the arrangement to continue thereafter from year to year until determined by either party giving 12 months' written notice to the other. The terms in brief provide for a fixed annual payment to the Corporation of £400 to £600, according to the amount of energy supplied, and for a charge of ¾d. per B. of T. unit. After a long discussion, the arrangement was confirmed. Mr. H. Webber, borough electrical engineer, was appointed permanently as tramways manager.

London.—Bermondsey.—Application is to be made to the L.C.C. for sanction to, and the advance of, loans of £500 for meters and £1,000 for services.

Hammersmith.—In a report to the B.C., the Finance Committee chairman states that the net surplus in the accounts of the electricity undertaking for the current year is estimated at £7,578, and he is of opinion that a sum of £3,340, part thereof, being equivalent to the produce of a penny rate, should be allocated to the relief of the general rate for the ensuing year.

Messrs. Walter Scott & Middleton have applied for a supply of electricity for driving their machinery in connection with the widening of the L. & N.W. Railway at Willesden Junction; also for the use of a 150-H.P. motor, and offering to pay a minimum of £250 per annum for current used, £65 per annum for the hire of the motor and £50 towards the Council's cost of laying on the supply. The Council has agreed to the above offer, and a supply is to be given at the flat rate of 1d. per unit.

Fulham.—An expenditure of £1,100 has been authorised for converting the remaining 121 rectified arc lamps in the borough to metallic-filament cluster lighting. This alteration, it is stated, may be expected to result in a further reduction in the number of units consumed and chargeable to public lighting of 68,483 per annum, which is equivalent to an annual saving of £345. An additional expenditure of £210 has also been authorised for converting 100 gas lamps, which are on the lines of mains already laid in the side streets of the borough, to incandescent electric lamps.

St. Pancras.—An agreement is to be entered into with the London Housing Society for a supply of current to its residences in Judd Street for lighting, heating and cooking purposes, upon payment by it direct, of an annual charge in advance, of £11 per KW. and ½d. per unit for all current supplied by meter. This is upon the condition that no gas is used by the society in any of the buildings. In assessing the KW. upon which payment would be made, the engineer estimated that 70 per cent. of the lamps in lighting at one and the same time could be considered as the maximum. The Electricity Committee reports having had under consideration the question of an undercharge which occurred in the accounts rendered for electric current supplied to the Railway Clearing House. In the year 1907, the Committee states, the voltage of the supply was changed from 110 volts to 220 volts, and at the Railway Clearing House three of the four 110-volt meters were replaced by 220-volt meters. In regard to the fourth meter, which was allowed to remain at 110 volts, inasmuch as it was one of special size and cost, the meter reading book was marked to be subject to a multiplying constant of two in making out the account. The reading of this meter for the quarter following was duly multiplied, and the account properly rendered, but the constant was subsequently omitted from the book, and, as a result, the current at 220 volts passing through this 110-volt meter was since then only charged at half its value. The total undercharge until the error was discovered amounted to £747. This sum, after negotiation, was settled in full. Arrangements were then made, the Committee continued, for a thorough and complete investigation of the meters in use, and it had been ascertained that the only other case of an error having occurred was in respect of a 220-volt meter which was connected to a 440-volt supply. This was responsible for an undercharge of £41, which had also been paid in full. The district auditor, in his remarks upon these errors, says that, in his opinion, "there is no reason whatever for supposing that the consumer was aware of the mistake. The substitution of metallic-filament lamps and the conversion to 220-volt current might easily have been regarded as sufficient explanation of the variation in charge. There are at present a number of 220-volt meters in use for measuring 440-volt current. In regard to them an efficient system has been instituted to obviate any risk of overlooking the constant, multiplier-cards of distinctive colour being used."

Luton.—It is stated that in all probability the profits of the electricity department will be absorbed by the proposed expenditure on house services, purchase of meters, &c. The question of installing new plant during the year, at an approximate cost of £20,000, is under consideration. In connection with the lease of the Corporation tramways, which expired on February 21st last, Messrs. Balfour, Beattie & Co., Ltd., the lessees, have now asked for a considerable reduction in the price of energy. The company suggested that the price should be, for the first 200,000 units per annum, 1¼d. per unit; for any quantity exceeding 200,000 units per annum, 1d. per unit. If this alternative was accepted, the company stated that it would be prepared to give the Council an option to determine the lease at any time upon 12 months' notice. Being of the opinion that it would be an advantage to have the power of determining the lease during the next 10 years, the Committee decided to agree to the proposal, subject to a fuel clause.

New Zealand.—Until recently the water of the Waipori River, which supplied the hydro-electric plant at Dunedin, was conveyed in an ordinary open flume. The risk and expense attached to its use led the Corporation to tunnel through a hill, some 4,440 ft., and in January last the water was diverted to the new course. The immediate result was to give the city an additional 1,000 H.P., making 4,000; two more generators are being installed, which will bring this up to 6,000 H.P., and it will be possible to develop an additional 4,000 H.P. in the future. The tunnel has an advantage over the open flume in that it can be used as a pipe line, supplying direct to the Pelton wheels and avoiding waste of excess water as heretofore. The tunnel, a new weir, and conduit have cost £39,752.

Oldham.—The B. of G. has decided to have electric lighting and telephones installed at the Workhouse.

Some time ago the Electricity Committee decided to install plant for supplying H.T. energy, and at a recent meeting of the Committee it was reported that there was not space available at the Greenhill station for the erection of the necessary switchboard, the engineer suggesting an extension on the eastern side fronting Churchill Street. This was agreed to by the Committee.

Peterborough.—The T.C. has discussed the extensions of the electricity works, for which a loan has been agreed upon. The city electrical engineer is to prepare a specification for a 500-KW. turbo-generator and two Lancashire boilers. The engineer was also instructed to make inquiries as to the value of various mechanical stokers and to report.

Rhosllanerchrugog.—The local Traders' Association has taken up the question of a supply of electricity for the district. A supply could be obtained from Wrexham by means of the tramway wires, this being considered the cheaper method, but the Association has decided to make further inquiries as to the possibility of current being generated in the town.

Southampton.—A letter has been received from Itchen U.D.C. with reference to the Council's schemes for supplying current, to the effect that the District Council favoured the proposal for a bulk supply on a six-years' contract. It is estimated that there will be a gross profit on the electricity undertaking for the year ending March, 1914, of £21,057, which, after deducting interest on redemption charges and special expenditure, will leave £1,879 available for appropriation.

Stirling.—At a meeting of the Lighting Committee it was reported that the capital account of the electric light undertaking was overdrawn to the extent of £115. It was recommended that £1,000, the balance of a sum authorised, be borrowed, and the T.C. has agreed to this. Recently the Committee met at the works and inspected the plant.

Swansea.—The question of increasing the contribution of the electricity department to the rates, was recently discussed by the E.L. Committee, and it was agreed to give one-third of the net profit for this purpose. It was pointed out that increased financial charges would have to be met shortly; that the reserve fund had not reached the 10 per cent. limit; that it would probably be necessary to pay for meters and street lighting out of revenue, to which the borough treasurer demurred; also that the price of gas was being reduced, all excellent reasons for retaining any available surplus in the undertaking.

Theale (Somerset).—There is every prospect of this village being supplied with electricity from Wedmore, where a scheme has been carried out. Prominent residents have taken up the matter, and the proposal has been favourably received.

Troon (Ayrshire).—The T.C. has under consideration the question of an electric lighting scheme for the borough.

Truro.—At the recent inquiry into the schemes promoted by the Corporation and the Truro Gas Co. for the electric lighting of Truro, counsel for the Corporation said the company was asking the B. of T. to ignore the Corporation—an unprecedented step. The Mayor of Truro gave evidence, and said the citizens were also against power being given to the gas company. Dr. Purves, of Exeter, said Truro was an exceedingly good field for the establishment of an electricity works. The capital expenditure he placed at £8,000. This, at 4 per cent., together with sinking fund, could be paid off at the rate of £520 annually for 25 years. To show the extent to which it was expected electric light would be taken up, Dr. Purves stated that Launceston, with a population of 4,500, had 3,700 lamps connected at the end of the first year, and Paignton, with a population of 10,000, had 6,000 lamps. Councillor Lodge stated that all the population of Truro wanted electric light, and 95 per cent. would prefer it in the hands of the Corporation.

Tynemouth.—At a meeting of the T.C. on the 19th inst., Alderman Irvin announced the Electricity Committee's intention to reduce the tariff for lighting. He said that the works had done so well during the last two or three years that they had practically wiped out their deficit. Mr. Gregg added that the feeling of the Committee was that even a further reduction in the price of energy for illumination purposes might be made next year.

TRAMWAY and RAILWAY NOTES.

Bingley.—The U.D.C. has been recommended to make an offer to the Bradford Corporation to obtain a provisional order for a tramway from Ling Bob, Wilsden, to the Bradford city boundary, and to lease the tramway to the Corporation upon certain conditions; and also to accept the terms suggested by the Shipley Council as the consideration for its consent to the junction of the proposed Bingley tramway with the Shipley tramway at Nab Wood.

Birmingham.—The City Tramways Committee has decided to improve the service by the introduction of more vehicles. At present 511 cars are in use, but to meet the requirements of traffic by extension of lines and also during the busy hours of the early morning and evening, it has become necessary to provide additional rolling stock. As a first instalment 40 more cars are to be purchased, some of which will be used on the Hagley Road route when the line is opened. The others will be utilised to increase the existing services in the city. Land has been purchased for the widening of Warwick Road and Stratford Road, and the work of laying the track, &c., will be carried out in the course of the summer. This work comprises the extension of the Stratford Road tramways from College Road to Hall Green, and also the completion of the line along Warwick Road.

Blackpool.—A petition signed by 2,000 ratepayers has been presented to the Tramways Committee calling for penny fares on the Promenade during the summer. The Committee has deferred consideration of the matter until it goes into the estimates for the ensuing year.

Bolton.—Despite the unfavourable weather which prevailed during the greater part of the day, the Corporation tramcars were extensively patronised on Good Friday, the receipts being about £100 in excess of the previous year's.

Bradford.—The Lord Mayor, on Monday, opened the extension of the tramway between Wyke and Bailiff Bridge, which provides a through connection between Bradford and Brighouse, thus making the second two-town connection in which Bradford is concerned. The new line opens up possibilities of an eventual through connection between Bradford and Huddersfield. The length of the new line is 1 mile 838 yd.; it is partly within the Bradford city boundary, partly in the Rural District of Hipperholme, and partly in the Halifax Rural District, and has been constructed on the Dawson & Foster patent reinforced system, at a cost of £22,000, which includes the special treatment of the road. It brings the total length of track now operated by the Corporation to 103 miles 1,096 yd., the capital expenditure being approximately £995,000. The Lord Mayor, accompanied by members of the City Council, officials and public men, travelled to the site in a gaily decorated car. The Mayor of Brighouse and other officials of that town were also present, and attended the subsequent luncheon at the Bradford Town Hall.

Bury.—The Tramways Committee at a recent meeting decided to continue the experiment of running tramcars to and fro on the Heywood Street route for a further period of one month.

Doncaster.—The extension of tramway at Bentley, which has been carried out at a cost of £3,750 by Mr. J. W. Pearce, of Morecambe, was formally opened for traffic last week, after an inspection by the B. of T. Inspector.

Edinburgh.—At a meeting of the T.C. the Tramway Committee, on a proposal to take over the undertaking of the Colinton Tramway Co., asked power to negotiate with the company, the Edinburgh and District Tramway Co., the War Department and other parties interested. The convener of the Committee advised that the Council should wait till next meeting, when it would have before it the printed report from the town clerk on the whole matter. This was agreed to.

Glasgow.—As reported in the Review recently, Glasgow Corporation gave limited powers to two committees to make general inquiries in connection with a proposal to erect a new bridge over the River Clyde in Glasgow, to relieve the congestion caused largely by the conveyance of tramway traffic in the centre of the city, and also to construct a dividing bridge lower down the river. A deputation has now been appointed to visit cities in which bridges suitable to Glasgow's requirements may be seen.

Hull.—The tramway employés are agitating for the reinstatement of a driver recently dismissed on account of a collision, and a general strike is threatened.

Leeds.—The people of the Farnley district, which is served by the railless traction system, are up in arms against the service, which they say is inefficient. They have ceased to grumble about the cars tearing up the roads, racking the passengers' nerves and splashing mud on people and buildings, have had a public meeting, which was addressed by the members for the district on the City Council, and have obtained 865 signatures to a petition asking for a better service. The proposals, which were put before the Tramways Committee by a deputation last week, include an increase in the number of cars, facilities for interchange of workmen's tickets both ways in case of breakdowns of the cars (which, it is alleged, are frequent), overlapping stages, a system of queues, and the provision of a waiting room at Moor Top.

Leicester.—The Corporation has initiated a service of pay-as-you-enter cars.

Liverpool.—A problem which is being considered by the Corporation Tramways Committee is to quicken the service of cars in the more congested parts of the city. At the present the Pierhead is the terminus for the majority of the cars, but the greater number of the passengers carried do not complete the journey to the landing stage, the cars both to and from the Pierhead and the business part of the city being comparatively empty, while considerable congestion exists in the city itself. A proposal has been brought forward to abolish in many cases the journey to the Pierhead, and return the cars more quickly through the town, which would have the effect of saving the present waste, and, at the same time, relieve the congestion by allowing a quicker service of cars on the various routes. Various proposals have also been suggested, with a view to avoiding duplication on the suburban routes, and it is also urged that the number of first-class cars is excessive, having regard to their returns.

London.—Last week trial runs were made over the recently electrified East London Railway, and the complete service is expected to be running on Monday next.

New Zealand.—The B.C. of New Plymouth has decided to take a poll of the ratepayers on a proposal to borrow £55,000 for the purpose of constructing electric tramways on the overhead system.

South Africa.—The Bloemfontein Corporation has now decided to proceed immediately with a railless traction system for the city at an approximate cost of £80,000.

Wallasey.—The Tramways Committee has recommended the Council to rescind the extension of the penny stages made 12 months ago, and to revert to the shorter stages.

Wath (Yorks.).—A ratepayers' meeting was held last week, which had been called by the chairman of the local Council with a view to obtaining the support of the ratepayers in the Council's opposition to the Mexborough and Swinton Tramways Co.'s Parliamentary Bill. The chairman explained that the opposition had arisen because the Mexborough and Swinton scheme did not embrace a wide enough area; the Wath Council desired the opinion of the ratepayers as to whether it would not be more to its advantage to attempt to run its own scheme of railless cars, instead of allowing the Mexborough and Swinton Co. to have a monopoly for 31 years, as was proposed in the Bill. The meeting decided to agree with the Council's opposition, and asked the Council to combine with neighbouring Councils for the establishment of a system of tramways under public control.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The application of the Marconi Co. for permission to inspect the wireless stations of the Commonwealth Government, in connection with the action for infringement of patents which is being brought against the Government by the company, was granted by the Federal High Court last week.

A full automatic service is to be established at Perth, W.A., and in Melbourne. The same course will be followed in other important centres when the present switchboards have to be replaced.

There are now eight wireless stations at work in Australia, of which six have been constructed by the Government staff under Mr. Balsillie. Ten more should be completed by June 30th next.—*Australian Mining Standard.*

Imperial Wireless System.—Two actions against *Le Matin* by Mr. H. Samuel, the Postmaster-General, and Sir Rufus Isaacs, the Attorney-General, were before the Court of King's Bench, presided over by Mr. Justice Darling, on the 19th inst. The actions arose out of an article published in the *Matin* on February 14th, in which allegations were made as to the conduct of the plaintiffs in relation to the Marconi contract. The *Matin* having published a full apology, the two plaintiffs only desired the opportunity of making a public statement in the witness box as to their position.

Sir Edward Carson, K.C., M.P., who appeared for the plaintiffs, said that the statement complained of was this:—"Mr. Leo Maxse, the eminent editor of the 'National Review,' protested vehemently against the way in which this agreement had been concluded. He imputed that Mr. Herbert Samuel, the Postmaster-General, whose idea it was to enter into the negotiations with the company, had entered into an arrangement with Sir Rufus Isaacs, the Attorney-General, and brother of Mr. Godfrey Isaacs." It was an absolute falsehood, said Sir Edward, to say it was Mr. Herbert Samuel's idea to enter into negotiations with the Marconi Co. The Attorney-General had never had anything to do with it. It had been alleged that they had bought Marconi shares at an average price of about 50 fr., at which the shares were quoted before the opening of the negotiations with the Government, and had resold them at a profit rising to as much as 200 fr. a share, according as the negotiations enabled it to be foreseen that the contract would be concluded. Neither of them ever bought shares in the company either in their own name or any other name, nor did anyone buy shares for them, nor were they ever interested in any option or syndicate, or in any transaction whatever in relation to the shares of the company. There were other Marconi companies. The American company was an independent company, which could have no interest in the contract at all. That company erected stations in America, and had no interest in the English company, although the English company had shares in it. The American company, subsequently to the tender, proceeded to raise capital, having bought out certain interests in America and made other arrangements which rendered an extension of capital necessary. Even the suggestion of the issue of shares did not come until some weeks after the tender of the English company had been accepted, but the Attorney-General, having heard of the American company and these shares, bought 10,000 shares at the market price premium. At the time the Attorney-General bought the shares, the British company's shares were at the very highest figure they had reached, so that any suggestion that the purchase of the American shares had anything to do with the price of these shares was entirely out of the question. He sold some of them, and amongst others he sold 1,000 to Mr. Lloyd George and another 1,000 to the Master of Elibank, believing them to be a good investment. The Attorney-General had 6,400 shares, and at the present price was a loser upon the transaction by about £1,000 to £1,500.

Mr. Herbert Samuel, the Postmaster-General, then went into the witness box, and, in answer to Mr. F. E. Smith, K.C., he corroborated the statement of counsel; he said the course pursued was absolutely in accordance with all previous precedents relating to Post Office contracts.

Sir Rufus Isaacs also entered the witness box and stated that he never had anything to do with the negotiations for the contract and never knew of the negotiations until just a few days before the announcement was made on March 8th, 1912. He never bought a share in the Marconi Co., either before or after, or at any time. He had never held a share, or had any interest in a share, nor had he ever had an interest in an option or syndicate, either in his own name or anybody else's name. He never heard of the shares, or of the constitution of the company in America, until his brother returned about April 8th or 9th of last year. He then heard that the American company were issuing shares to raise new capital to carry out special arrangements that had been made for the purchase of the assets of a competing company—the United Wireless Co.—which had gone into liquidation in America, and also some important contracts which had been made with the Western Union Cable Co. He bought 10,000 of the shares at the market price, but previously he satisfied himself that they had no interest with the British Government. His purchase in the American company had nothing to do with raising the price of the shares. He sold 1,000 of his shares to Mr. Lloyd George and 1,000 to the Master of Elibank, who were great personal friends of his. He would not have gone into it unless he had been satisfied that it had nothing to do with the Marconi Co. He sold 3,570 shares, and that sale averaged a profit which eventually brought the whole transaction to his having 6,430 left out of the 10,000. The net result of the transaction was that he had made a loss of about £1,100 or £1,200 if he sold the shares at the present prices.

Mr. Campbell, K.C., appearing for the *Matin*, described the circumstances under which the article complained of was written, and said that the moment the attention of his clients was called to it, they met it with an immediate apology and explanation.

Judgment was accordingly entered for the plaintiffs with an indemnity for their costs.

The Select Committee on the Marconi contract met on Thursday last week, and selected Sir Albert Spicer as chairman. The Committee met again on Monday, in private, and on Tuesday Sir Rufus Isaacs, the Attorney-General, was examined regarding his purchase of American Marconi shares. His evidence was given in minute detail, but in substance was the same as that given in the libel action against *Le Matin*. The examination was continued on Thursday.

In reply to questions in the House of Commons, Mr. H. Samuel stated that the American Marconi Co. had no interest at all in the British Marconi Co., but that the British Co. had a large interest in the American Co. He explained that there was no similarity between the case of Mr. J. E. Taylor and that of the Attorney-General and the Chancellor of the Exchequer, and that the reduction in rank of Mr. Taylor would not be reconsidered.

India.—The wireless telegraph station at Lahore has just been opened, and the new station at Bombay will be ready very shortly.—*Indian Engineering.*

Telephone Employés.—The eighth annual conference of the Amalgamated Society of Telephone Employés was held in Glasgow last week; 70 delegates were present, representing 10,000 employés. The outgoing president, Mr. O. Preston, stated that if a plebiscite of male members of the staff were taken, the vote would undoubtedly be in favour of a return to the old order of things.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—May 14th. Generating plant for Darwin Radiotelegraph Station, Northern Territory. See "Official Notices" to-day.

Victoria.—May 30th. High-tension switchgear with remote control, for the Melbourne City Council. See "Official Notices" to-day.

April 15th.—1,020,000 arc lamp carbons, 26,900 carbon-filament incandescent lamps, and bare hard-drawn copper cables, for the Melbourne City Council. See "Official Notices" to-day.

Sydney.—May 12th. Fibre conduit for the City Council. May 26th.—Meters and glazed stoneware bridges. July 7th.—Arc lamp carbons. Specifications 10s. 6d. for each section, from City Electrical Engineer's Department.—*Australian Mining Standard.*

Ayr.—Corporation tramways. Tenders for work in connection with Hawk Hill extension—permanent way construction, road widening, &c. Mr. J. Young, engineer, Town Buildings, Ayr.

Belgium.—March 29th. Municipal authorities of Ixelles-lez-Bruxelles. Armoured cables necessary for the low-tension distribution service.

Blackpool.—High and low-tension cables and transformer switch pillars. See "Official Notices" March 14th.

Buenos Ayres.—April 15th. Supply of motors, cables, dynamos and other accessories for motive power. Oficina de la Direccion General de Minas, Geologia e Hidrologia, Buenos Ayres.

Chorley.—Board of Guardians. Tenders for a complete telephone installation for the workhouse.

Croydon.—March 31st. Stores for a year, for the Corporation Electricity Department. See "Official Notices" Feb. 21st

Douglas (Isle of Man).—March 31st. About 190 tons of good steam coal for the Corporation tramways department. Mr. A. Robertson, Town Clerk.

Dundee.—April 4th. E.H.T. switchgear and transformers, for the Corporation. See "Official Notices" to-day.

The Corporation electricity department invites tenders for the supply of steel sashes and frames, and for the supply and erection of opening casements, for extensions at Carolina Port generating station. Mr. H. Richardson, general manager and engineer.

Edinburgh.—Electric lighting for the new Veterinary College buildings at Summerhall. Mr. D. M'Arthy, architect, 25, Frederick Street, Edinburgh. Deposit two guineas, returnable.

March 31st.—Coal for the Corporation electricity supply department for 3 or 12 months. Engineer's Office, Dewar Place.

France.—The electrical department of the French State Railways has just invited tenders for the supply of eight underground electric cables to transmit three-phase 15,000-volt current between the Nord power station in Paris and the sub-station at La Garenne.

April 5th.—The Bureaux du Service Electrique (Second Division of the French State Railways in Paris (43, Rue de Rome) are inviting tenders for the supply of the switchboards required on the alternating side at the transformer station at the Champs de Mars, Paris.

Glasgow.—The Tramways Sub-Committee on Works and Stores of the T.C. is inviting offers required under the annual contracts. Mr. James Dalrymple, general manager, Headquarters, Bath Street.

Hornsey.—March 31st. Natural draught cooling tower for the T.C. electricity works. See "Official Notices" March 14th.

Italy.—The Azienda Elettrica Municipale, of Rome, has just invited tenders for the supply of about 350 km. of copper conductors required in connection with the electric transmission installation between Castelmadama and Rome.

Keighley.—(*a*) Foundation work for a 2,000-KW. turbo-alternator and condensing plant at the electricity works; (*b*) rolled steel joists in connection with the above. Drawings and specifications obtainable from Mr. H. Webber, Borough Electrical Engineer, Coney Lane, Keighley.

Limerick.—April 10th. Stores and materials for a year, for the Borough electricity department. See "Official Notices" to-day.

Lisnaskea (Co. Fermanagh).—April 14th. Gas engine and suction gas plant, dynamo and booster, battery, wood poles, overhead mains, &c., and switchboard, for the Lisnaskea Electric Light Co., Ltd. See "Official Notices" to-day.

London.—L.C.C.—April 3rd. Reconstruction and rewinding of seventeen 300-KW. synchronous motor-generators and three 500-KW. induction motor-generators. See "Official Notices" March 14th.

April 2nd.—Electrical installation at the Avery Hill Hostels, Eltham, S.E. See "Official Notices" March 21st.

BATTERSEA.—April 1st. Coal for a year, for the B.C. Electricity Department. See "Official Notices" March 14th.

LEWISHAM.—March 31st. Guardians. Wiring and fittings for 500 lights at the workhouse, and 500 lights at the infirmary, in High Street, Lewisham, S.E. Specifications at Union Offices, 394, High Street.

Manchester.—April 1st. Electric fittings and wires, &c., for a year, for the Lancs. and Yorks Railway Co. Mr. Waring, Stores Department, Osborne Street, Manchester.

April 15th.—Tramways Committee. Tenders for roofing over of avenues at the Hyde Road car works, Manchester. Mr. J. M. McElroy, General Manager.

Maryborough.—April 9th. 1,120-amp.-hour accumulator, for the District Asylum. See "Official Notices" to-day.

Peterborough.—March 31st. 1,023 yards of cable, for the Corporation. See "Official Notices" March 21st.

Salford.—March 31st. Stores, &c., for the Corporation Electricity Department. See "Official Notices" March 21st.

April 10th.—Extra-high-tension switchgear, for the Corporation. See "Official Notices" to-day.

Shanghai.—April 3rd. Extra-high-tension and low-tension switchgear for sub-stations. See "Official Notices" March 14th.

Spain.—The municipal authorities of Epila (province of Zaragoza) have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

Stalybridge.—4,500 yards E.H.T. three-core lead-covered cable. See "Official Notices" March 14th.

West Ham.—April 3rd. Electric light installation at the new workshops, Aldersbrook Road, Wanstead, for the Guardians. See "Official Notices" to-day.

Wigan.—March 31st. Materials and stores for the Corporation Light and Tramways Departments. See "Official Notices" March 14th.

York.—April 5th. The Board of Guardians is prepared to receive tenders for (1) a dug well round an existing bore hole, an additional cast-iron liner down the bore hole, a deep well pump for 5,000 gallons per hour, and two small centrifugal pumps and electric motors; and (2) water-softening plant (without heat) dealing with 5,000 gallons per hour. Tenders to the Clerk (Mr. George Sykes), Union Offices, Museum Street, York.

CLOSED.

Ashton-under-Lyne.—The Electricity Committee has provisionally accepted the tender of Messrs. Switchgear & Cowans, Ltd., for high-tension switchgear to specification.

Atherton.—The U.D.C. has accepted the tender of Messrs. Manchell, Barratt & Co. for two transformers.

Bristol.—The Docks Committee has accepted the tender of Buchanan & Curwen for the electric light installation at Bathurst and Prince's sheds.

Burnley.—The Guardians, on March 20th, entered into their half-yearly contracts. These included one for electrical requirements with Messrs. Simpson Bros.

Chesterfield.—The T.C. has accepted the tender of the British Westinghouse Co., Ltd., for a 500-KW. rotary converter, speed 600 R.P.M., and a 500-K.V.A. transformer, at £1,461.

Australia.—According to the *Australian Mining Standard*, the following contracts have been placed:—

HOBART.—Postmaster-General's Department:—
46 chains cable, 260 pairs, £425.—B.I. and Helsby Cables, Ltd.
118 chains cable, 208 pairs, £835; 54 chains cable, 150 pairs, £311.—Australian Metal Co., Ltd.

VICTORIAN RAILWAYS. Electrical equipment of Melbourne suburban system. (This matter has already been mentioned in the ELECTRICAL REVIEW):—
Power station, buildings, boiler house equipment and other plant—deposit, £6,455 10s.—£258,220.—Babcock & Wilcox, Ltd.
Equipment of suburban stations—deposit, £4,200—at rates.—Siemens Bros. Dynamo Works, Ltd.
Turbo-alternators and transformers—deposit, £3,056—£122,235.—C. A. Parsons & Co.
Train equipments—deposit, £16,904—£676,180.—General Electric Co. (U.S.A.).

NEW SOUTH WALES.—Public Works Department. Building works:—
Construction of electric lifts, Registrar-General's new building, £2,035.—Standard Waygood, Ltd.
Railway and tramway construction works.—100 tons of fishbolts for 80-lb. rails, £15 per ton.—R. W. Cameron & Co., Sydney.

SYDNEY.—Municipal Council:—
Maximum demand indicators, £308.—W. G. Watson & Co.
Transformers, £1,239.—Australian General Electric Co.

Clacton-on-Sea.—The U.D.C. has accepted the tender of the Consolidated Diesel Co., Ltd., for an engine and accessories and switchboard, at £4,840, and a Crompton dynamo, at £710; and that of Messrs. Johnson & Phillips, Ltd., for cables for extensions, at £56.

France.—The adjudications on the tenders returnable on March 11th, for telephone cables (in three lots) for the Post and Telegraph Department, Paris, have resulted in the rejection of all the offers made, owing to them exceeding the price limit previously fixed. The lowest tender for lot 1 (10,000 metres of copper cable and 28 pairs of silk and cotton-bound conductors) was 1,900 fr. per kilometre, by M. Grammont. The lowest tender for lot 2 for similar requirements, was 1,885 fr. by Messrs. Geoffroy & Delore, the India-Rubber, Gutta-Percha and Telegraph Works Co.'s tender being 1,925 fr. per kilometre. For lot 3 (15,000 metres and 14 pairs), the lowest tender was that of the Tréfileries du Havre, 1,210 fr.

The tenders invited for the same date, for extensable commutator telephone tables, were also rejected for the same reasons. The lowest tender was that of the Société des Ouvriers en Instruments de Précision, 50,126 fr. for two lots, the Thomson-Houston quotation being 52,700 fr. for two lots.

Germany.—Messrs. Heh. Riecke & Co., of Kassel, have submitted the lowest tender to the Prussian State Railway authorities of Munster for the supply and erection of five 80-ton electrically-operated cranes.

Glasgow.—The T.C.'s Tramways Committee on Works and Stores has recommended acceptance of the following offers:—
Porcelain insulators.—Bullers, Ltd.
Copper bonds.—R. R. Todd.
Witting armature coils.—Manchester Armature Coil Co.
Witting commutators.—Mavor & Coulson.

Government Contracts.—The following tenders have been accepted during the past month by the Government departments named:—

ADMIRALTY: CONTRACT BRANCH.
Bell, bell fittings, gongs, &c.—Hawkers, Ltd.; India-Rubber, Gutta-Percha, &c., Co., Ltd.; McGeoch & Co., Ltd.; Mechan & Sons, Ltd.; Player and Mitchell; Reid Bros., Engineers, Ltd.; Spagnoletti, Ltd.
Brackets, pendants, &c.—Evered & Co., Ltd.; Edison & Swan, &c., Co., Ltd.; Gabriel & Co.; General Electric Co., Ltd.; Mechan & Sons, Ltd.; W. McGeoch & Co., Ltd.; Player & Mitchell, Ltd.; David Shanks and Co., Ltd.; Spagnoletti, Ltd.
Lampholders and insulators for.—Edison & Swan, &c., Co., Ltd.; General Electric Co., Ltd.; W. McGeoch & Co., Ltd.
Incandescent lamps.—British Union Lamp Works, Ltd.; British Thomson-Houston Co., Ltd.; Crysselco, Ltd.; Edison & Swan, &c., Co., Ltd.; General Electric Co., Ltd.; Rugby Lamp Co., Ltd.; Pope's Electric Lamp Co., Ltd.

WAR OFFICE.
Electric dry cells.—Atlas Carbon and Battery Co., Ltd.; Siemens Bros. and Co., Ltd.
Installation of electric light, officers' houses, Tidworth.—Malcolm and Allan, Ltd.

INDIA OFFICE: STORE DEPARTMENT.
Pipettes, &c.—Chloride Electrical Storage Co.

CROWN AGENTS FOR THE COLONIES.
Cable.—W. T. Henley's Telegraph Works Co., Ltd.
Dynamo sets.—Britannia Engineering Co., Ltd.
Switchboard meter equipments.—Western Electric Co.

POST OFFICE.
Protective apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co.
Telegraphic apparatus.—B.I. and Helsby Cables, Ltd.
Telephonic apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British Insulated and Helsby Cables, Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; Crystalate Manufacturing Co., Ltd.; Edison and Swan United E.L. Co., Ltd.; General Electric Co., Ltd.; International Electric Co.; London Electric Wire Co. and Smiths, Ltd.; Siemens Bros. & Co., Ltd.; Spagnoletti, Ltd.; Western Electric Co., Ltd.
Telephonic cable.—B.I. and Helsby Cables, Ltd.; Johnson & Phillips, Ltd.
Stoneware ducts.—Albion Clay Co., Ltd.
New wireless station, Malin Head.—Robert Colhoun.
Power plant and wiring at Malin Head wireless telegraph station.—Westminster Engineering Co., Ltd.
Steel masts at Valencia wireless telegraph station.—Marconi's Wireless Telegraph Co., Ltd.
Telephone exchange equipment, Leith; alterations and additions, Mayfair Exchange, London; information desks and alterations, City and Central Exchanges, London.—Western Electric Co., Ltd.
Telephone exchange equipment, Barnsley and Helensburgh.—Peel-Conner Telephone Works, Ltd.

Herne Bay.—The U.D.C. has accepted the tender of Messrs. Stuart & Moore, of Ealing, for an installation of electric fire alarms, at £27 a year, for five years.

Hornsey.—The tender of the Reason Manufacturing Co., Ltd., for electrolytic meters for the ensuing year, has been accepted by the Council.

Messrs. Chamberlain & Hookham, Ltd., have also obtained a contract for meters from the B.C.

Huddersfield.—The Electricity Committee has accepted the following tenders :—

Mark Brook.—New chimney at electricity works.
H. Brook & Co.—Tanks.

Ilford.—The U.D.C. has accepted the following tenders for coal for the electricity works :—

Bradbury, Son & Co , Ltd.—2,000 tons of Gedling small peas, 14s. 6d. per ton.
E. Foster & Co.—7,000 tons of Ibstock medium peas, 15s. 5d. per ton, and 1,000 tons of Tamworth double-screened nuts, at 16s. 2d. per ton.

The Education Committee has accepted the tender of Messrs. Ellis & Ward, Ltd., for the electric light installation at South Park Schools, at £157.

London.—Hammersmith.—As the result of tests made of prepayment meters recently tendered for, the tender of Messrs. Chamberlain & Hookham was recommended for acceptance.

The tenders received for arc lamp carbons were :—

Electrical Engineering and Equipment Co., Ltd. .. (accepted)	£187
Ship Carbons	149
W. Geipel & Co.	148*
J. G. Wilson	153
Siemens Bros Dynamo Works, Ltd.	154*
H. G. Mayer & Co.	170
Sloan Electrical Co.	178
General Electric Co., Ltd.	198
Crompton & Co., Ltd.	207

* Net; others less 2½ per cent.

Battersea.—The B.C. has accepted the following tenders for annual supplies to the Electricity Department :—

Carbon lamps.—British Thomson-Houston Co., Ltd.
Oils.—Price's Co., Ltd.
Turbine oil.—A. Duckham & Co., Ltd.
Bitumen.—Callender's Cable and Construction Co., Ltd.
Compound.—Dussek Bitumen Co.
Engine room stores and ironmongery, &c.—Pryke & Palmer.
Packings.—R. Meldam.

Fulham.—The B.C. has accepted the following tenders for annual supplies :—

Carbon brushes.—W. Geipel & Co.
House cut-outs and service boxes.—B.I. and Helsby Cables, Ltd.; Sykes and Sugden.
Glass globes.—City Glass Co.
Electrical goods.—British Thomson-Houston Co., Ltd; Siemens Bros. Dynamo Works; W. T. Henley's Telegraph Works Co., Ltd.
Carbons.—Sloan Electrical Co. (for about seven months only).
Frames and covers.—W. T. Henley's Telegraph Works Co., Ltd.

Ealing.—At an estimated cost of £130, with an additional £15 for foundation work and fitting, Messrs. Weir, Ltd., are to be requested to provide at the electricity works, a Weir boiler feed pump to take the place of the two small ones which have been working for nearly twenty years and are now almost unfit for further service.

Stoke Newington.—The tender of the London Electron Works Co, Ltd., has been accepted for the purchase and removal of old tinned material and galvanised iron, &c., from the Stoke Newington destructor for three years, at £1 10s. per ton for tinned material, and 12s. 6d. for the iron, &c.

Bermondsey.—The B.C. has accepted tenders by the following firms :—

Reason Manufacturing Co.—Time switches and demand indicators.
E. H. Cripps.—Meter boards.
Stern, Sonneborn Oil Co., and W. B. Dick & Co.—Engine oils.
Thos. Wragg & Co., Ltd.—Conduits and troughing.
Sykes & Sugden, Ltd.—Street frames and covers, &c.
Chamberlain & Hookham, Ltd.—Meters, fuses and time switches.
General Electric Co., Ltd.—Cut-outs, &c.
Union Cable Co., Ltd.—Paper cable, lead-covered.
Liverpool Electric Cable Co., Ltd.—Rubber cable.
C. Macintosh & Co., Ltd.—Lead-covered rubber cable.
Siemens Bros. & Co., Ltd.—Lead-covered cable.
Craig, Sharp, Ltd.—Jointing material.

Manchester.—The B. of G. has placed a contract with Messrs. Anderson, Ltd., Salford, for installing electric light at Crumpsall Workhouse.

New Zealand.—Messrs. Hick-Diesel Oil Engines, Ltd., have received the following Colonial orders for their oil engines :—

Te Aroha Borough Council, N.Z.—One of 240 B.H.P.
Corporation of Thames, N.Z.—Two of 160 B.H.P.

Norwich.—The T.C. has accepted the tender of Messrs. Alexander Wilson, of Aberdeen, for a two-cylinder electric motor-driven air compressor for New Mills power station, at £421.

Salford.—The Education Committee has accepted the tender of Messrs. Willoughby & Wilcox for installing the electric light at the technical laboratories and workshops, at £40; and that of Messrs. Davenport, Sparrow & Co. for similar work at the juvenile employment bureau.

York.—The Cable Accessories Co., Ltd., have secured the contract for supplying brackets and fittings for lighting the streets of the city.

Southend-on-Sea.—The T.C. has accepted the following tenders :—

Edgar Allen & Co., Ltd.—20 manganese iron tongues for tramways, £90.
Worthington & Co.—Poles, brackets, trolley wire, section pillars and bonds, £801.
Mr. D. B. Rose.—Gun-metal overhead line material, £41.
Aiton & Co.—Steam pipes, £35, and exhaust pipes, £76.
Hopkinson & Co.—Steam valves, £76.
Glenfield & Kennedy.—Exhaust valves, £23.

The British "Niclausse" Boiler Co., Ltd., has secured from the Corporation a contract for two 25,000-lb. capacity boilers, complete with Niclausse stokers, superheaters and forced draught fan equipment, also Green's economisers and other work.

FORTHCOMING EVENTS.

Manchester Electro-Harmonic Society.—Friday, March 28th. At the Albion Hotel, Manchester. Last concert of the season.

Association of Mining Electrical Engineers (South Wales Branch—Western Section).—Saturday, March 29th. At 7.30 p.m. At the Grammar School, Swansea. Lecture on "Turbine Engines, their Construction, Installation and Maintenance," by Mr. A. L. Ohlson.

(South Wales Branch—Eastern Section).—Saturday, March 29th. At 5 p.m. At the Carlton Café, Cardiff. Discussion on paper on "The Speed Control of Three-phase Motors," by Mr. S. Simons.

Institution of Electrical Engineers (Scottish Section).—Annual general meeting postponed from April 8th to April 15th.

(Newcastle Section).—Monday, March 31st. At 7.30 p.m. At the Armstrong College, Newcastle. Paper on Telephonic Development," by Mr. J. R. Andrews.

(Manchester Section).—Tuesday, April 1st. At 7.30 p.m. At the University, Manchester. Paper on "Self-synchronising Machines," by Dr. E. Rosenberg.

Association of Electrical Station Engineers (Glasgow Branch).—Wednesday, April 2nd. At 7.45 p.m. Meeting at the Y.M.C.A., Bothwell Street, Glasgow.

Electro-Harmonic Society.—Friday, April 4th. King's Hall, Holborn Restaurant. Last Smoker of the season.

Salford Technical and Engineering Society.—Saturday, April 5th. At 7 p.m. At the Royal Technical Institute, Salford. Paper on "Modern Gas Engines," by Mr. K. Cox.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—Lieut.-Col. H. M. Leaf.

The following orders have been issued :—

Friday, March 28th.—"D" Company. Company training, 7 to 10 p.m.

Saturday, March 29th.—Headquarters will be opened from 10 a.m. till 12 noon for regimental business only.

Monday, March 31st.—"A" Company. Recruit training, 7 to 10 p.m.; company training, 7 to 10 p.m.

Tuesday, April 1st.—"B" Company. Company training, 7 to 10 p.m.

Thursday, April 3rd.—"C" Company. Recruit training, 7 to 10 p.m.; company training, 7 to 10 p.m.

Friday, April 4th.—"D" Company. Company training, 7 to 10 p.m.

Saturday, April 5th.—Headquarters will be opened for regimental business from 10 a.m. till noon.

(Signed) J. H. S. Phillips, Major.
For Officer commanding L.E.E.

NOTES.

The L.C.C. Highways Committee.—The members of the new Highways Committee (which, as our readers know, looks after the electric tramway system) will be as under :—

Cotton, H. E. A.	Kennard, Cpt. A.C.H.	Scott, A. H.
Evans, B. B.	Lidiard, H.	Squires, W. J.
Goodrich, A. O.	Monk Bretton, Lord	Ward, Henry
Gordon, H. H.	Prestige, J. T.	White, Sir Edward
Hume, G. H.	Rawson, A. C.	Yeo, A. W.
Hunt, William		

Electric Motor-Vehicle Construction in the United States.—The Edison Electric Vehicle Co., of America, is the name of a new concern which has just been formed at Lawrence, Mass., to manufacture industrial motor-vehicles of the electric type. The vehicles will all be fitted with Edison batteries.

Rugby Engineering Society Conversazione.—The third Conversazione held under the auspices of the Rugby Engineering Society took place on the evening of the 14th inst. in the Co-operative Hall, Rugby. This function is held about every two years, and is one of the most successful and interesting displays of the results of engineering progress and scientific research in the Midlands. The large hall was used for the display of exhibits, and of the two smaller halls attached, one was reserved for a lecture and demonstration theatre—there being during the evening continuous demonstrations of the Pathéscope, by the courtesy of the Pathéscope Co., interspersed with two very interesting lectures; one by Mr. E. B. Wedmore, entitled "Infinity," which, in spite of the awe-inspiring title, thanks to the wit and humour of the lecturer, was much enjoyed by a numerous and appreciative audience. The second lecture was by Mr. F. A. Haigh, on "Coloured Photography," in which a demonstration was given with suitable examples of this interesting development of the art. The second small hall was reserved for refreshments, and a most instructive and enjoyable evening was spent by some 400 members and their friends, a continuous programme of music being provided in the main hall throughout the evening by Mr. Dadley's orchestra. The Marconi Co. sent down a complete wireless installation, with one of their engineers to demonstrate the working of the equipment. There was an excellent demonstration of the X-rays, with specimen photographs, &c. Messrs. Alfred Herbert, Ltd., of Coventry, gave a practical demonstration of the photostat, using mercury lamps. Mr. Robert W. Paul, of London, exhibited a comprehensive collection of electrical instruments, and the Cambridge Scientific Instrument Co. sent a very comprehensive exhibit of their specialities. One of the most popular demonstrations was that of the effect of rotary alternating magnetic fields, by means of apparatus kindly loaned by Dr. Sumpner, of Birmingham, and many other very interesting exhibits were shown. Great credit is due to the Committee responsible for the arrangements, and particularly to the joint hon. secretaries, Messrs. R. G. Hosking and J. M. Ferguson, for having so successfully organised a conversazione which, on its social, as well as its scientific side, it would be difficult to surpass.

Strike at Barrow.—There has recently been a strike of Corporation employés in progress at Barrow-in-Furness. Although most of the workmen in nearly all departments went out on strike, the whole of the men in the electricity department, with the exception of two or three casual labourers, who were interfered with while at work, remained loyal, in spite of desperate efforts on the part of the Labour Party and agitators to get them to go out on strike. As a result, there was no interference of any sort with the electricity supply, and a number of Mr. Burnett's staff assisted at the gasworks, which, for some days, were largely run by the officials from the various departments. The gas supply was maintained at a reduced pressure, but none of the gas street lamps were lit. Fortunately, however, most of the main thoroughfares are lighted by electricity, and the fact that the electricity supply was maintained, of course, made the inconvenience caused by the strike very much less than it would otherwise have been. Under ordinary circumstances there is a keen but friendly rivalry between the electricity and gas departments, but, in the present instance, the former co-operated with and assisted the gas department in every possible way in the fight against their "common enemy—the labour agitator."

Later information received just as we go to press states that the strike still continues. A few of the men have returned to work, and the places of some have been filled. The gas supply is being maintained at reduced pressure by volunteers, but none of the gas street lamps are yet lit.

Copper.—Messrs. H. R. Merton's mid-monthly statistical circular, which is now to hand, shows a drop, during the fortnight ending March 15th, of 1,034 tons in visible supplies. This includes 932 tons withdrawn from English ports. Dutch stocks (also included) are up 850 tons, and Hamburg stocks 125 tons. Deliveries, at 24,379 for the fortnight, will, if continued at the same rate, show a fairly brisk trade on the month. North America's contribution is high, Spain's very low, Chile shipments average, and Australian the same. The world's supply figures for the end of February again show an increase (1,172 tons), though not so large as the preceding one. At 99,273 tons they stand higher than they have done since 1911. Stock in American producers hands on February 28th, however, was 400 tons less than on January 30th, the increase in world's supplies, therefore, depending on the increase in Dutch and German stocks. Without these the European supplies are 2,009 tons down for the half-month, and the combined visible supply lost 2,452 tons during February.

Charge of Receiving.—At the London Sessions on 17th inst., Abraham Viner, a rubber dealer of Walworth, was charged with receiving six magnetos belonging to the Bosch Magneto Co. According to the *Morning Advertiser's* report, complaints were made that the company's consignments of magnetos to Australia arrived short of the proper number, paving stones of about the same weight having been substituted. There was no direct evidence to show when the cases were tampered with, but investigations led to the discovery that the prisoner had disposed of six of the magnetos at much below cost price. The accused was found guilty of receiving one magneto, and he was remanded in custody until April 10th, when the judge will give his decision.

The Batti-Wallahs.—The eighth annual dinner of the Batti-Wallahs' Society was held on Saturday, March 15th. The toast of "The King" constituted the toast list, and Mr. Collis, the retiring President, who took the chair, pointed out that there was no necessity for him to make a speech, since all he could say about the Society was to be found in the menu-programme and the Batti-Wallahs' *Journal*, the second number of which was published in time for distribution at the dinner. We understand that Mr. Robinson, the entertainment secretary, displayed originality in stage-managing the whole affair. The menu took the shape of a uniform cap, and inside there were amusing illustrations depicting the seven ages in the life of an electrical engineer. Mrs. J. Corneille, Mr. Martin Muir, Miss Ada Fox, Mr. Olley Oakley, Mr. Ernest Pike and Mr. Louis Nikola entertained the guests. During the course of the evening Mr. J. Snow Huddlestone, the President for the ensuing year, who had a previous appointment, called in, and, in response to a general request, gave a short speech. We are informed that "there was a record attendance, in spite of the unavoidable clashing of dates."

A Glasgow Electrical Exhibition.—The Glasgow Corporation Electricity Department is organising an Electrical Exhibition (incorporating engineering and machinery) to be held from Thursday, October 23rd, to Saturday, November 15th, inclusive. An official preliminary circular, issued by the general manager (Mr. James M. Freer, 38, Bath Street, Glasgow), states that the scope of the exhibition will embrace lighting, heating and power, and a special section will be devoted to appliances for domestic purposes. Careful attention will be given to a section illustrating electrical applications to light railways, mining, textile, and every branch of manufacture. "The exhibition will afford a unique opportunity to engineering and machinery manufacturers to exhibit their specialities in conjunction with electric power appliances. The management will make special endeavours to bring the exhibition to the notice of likely users of electrical equipment in all parts of Scotland and the North of Ireland." The complete prospectus will be circulated a few weeks hence.

Association of Electrical Station Engineers.—A meeting was held recently at the Mechanics' Institute, Bradford; 16 gentlemen were present, and these included representatives from Colne, Dewsbury and Keighley, as well as Bradford. It was unanimously agreed that a branch of the A.E.S.E. be formed for Bradford and district. An hon. secretary was appointed, and it was decided to form a committee of 12. A number was elected from those gentlemen present, and a few vacancies were left to be filled by representatives of other districts around Bradford, who, it is hoped, will attend at the next meeting.

It was proposed that when the A.E.S.E. gets into working order, a magazine be published and sent to members. It was also proposed that the A.E.S.E. become incorporated.

All the gentlemen present promised to make application for membership at once if they had not already done so, and to do their best to obtain members; those from outlying districts promised to canvass the particular districts from which they came.

The next meeting was provisionally arranged for April 16th, and it is hoped that there will be a larger attendance.

A meeting was held at the Amalgamated Society of Engineers' premises, Mount Pleasant, Liverpool, on Thursday last. There was a representative attendance, and it was unanimously resolved that a branch be formed for Liverpool district and the Cheshire side of the Mersey. Mr. A. Chas. Black was elected hon. secretary, with Mr. F. A. Taylor hon. assistant secretary, and a committee of seven was appointed for the time being. It was resolved that the next meeting be held in about two weeks' time.

Alleged Fraud.—On 19th inst., at Marlborough Street Police Court, Horace Gustave Ménage, 31, described as an electrical engineer, living in Junction Road, Upper Holloway, was charged with obtaining on divers dates between November, 1912, and January, 1913, with intent to defraud, a quantity of electrical accessories of the value of £24 8s. 11d. from Walter James Spencer and others of the Sun Electrical Co., 118, Charing Cross Road, W.C.

According to a report in the *Morning Advertiser*, Mr. R. T. Smith, who prosecuted, said that the prisoner in 1902 entered into an agreement with the Telephone Instalment System Co., Ltd., of High Holborn, and by the terms of it he was forbidden to order any goods for that firm unless their printed forms, duly signed by the manager, managing director, or the secretary, were used. It was alleged that the accused disregarded this arrangement, and ordered goods from the Sun Electrical Co., representing that they were required by the Telephone Instalment System Co. In this way he obtained goods of the value of £24 8s. 11d., which he appeared to have applied to his own use. Mr. Smith said he also proposed, in addition, to charge the prisoner with forgery, he having altered a genuine order and made an addition to it.

Mr. R. Bos, managing director of the Telephone Instalment System Co., said that by the agreement entered into with his company the prisoner was to manage the electrical department, and was to have a third of the profits of that department over and above the cost of the work. He was not allowed to order goods for them unless the printed forms of the company, signed by the manager, managing director, or secretary, were used. The goods referred to in the charge had not been ordered by them. The business of the company was to supply telephones on the instalment system, and also to carry out work in connection with telephones.

Mr. Denman, on the application of Mr. Lewis, remanded the prisoner, allowing bail in two sureties of £30 each, or in one in the sum of £60.

Edison Battery Car for Glasgow E.L. Department.—The electrically propelled motor-van which the Electricity Committee of the Corporation has purchased has a load capacity of 1 ton, and is equipped with an Edison storage battery. The energy cost for a run of 40 miles is said to be less than ½d. a mile.

(*Continued on page 527.*)

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POWER SUPPLY ON THE RAND.

On Thursday, March 13th, a paper was read before the Institution of Electrical Engineers on this subject, by Mr. A. E. Hadley, M.I.E.E., managing director of the Victoria Falls and Transvaal Power Co., Ltd., which was formed at the end of 1906, with the object of supplying power in South Africa and Rhodesia and of acquiring the concessional rights to develop the Victoria Falls. We give below an abstract of the paper, together with reproductions of the lantern slides, for the use of which we are indebted to the courtesy of the author.

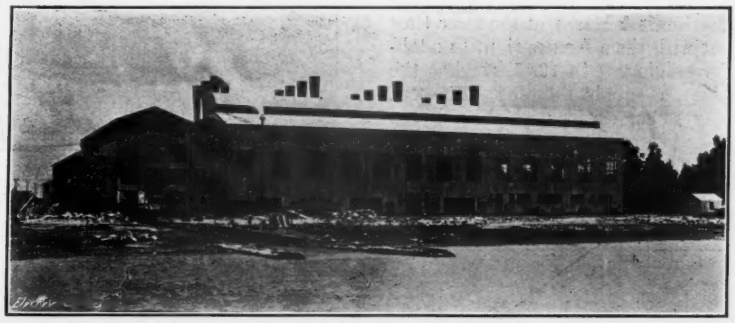


Fig. 1.—Exterior of Rosherville Generating Station.

Under the original proposal a supply to the Rand was to be given partly by transmitting power from the Victoria Falls, 700 miles distant, and partly by steam generating stations located on the reef. The author became associated with the company shortly after its formation, and after its original proposal had been modified through giving up the plan to supply part of the requirements of the Rand with power from the Falls.

The great demand for power on the Witwatersrand has arisen through the extraordinarily successful development of the gold mines on the reef, which, although only discovered in 1886, now produce 33 per cent. of the world's output of gold. Further, it is estimated by the leaders of the gold-mining industry that the work of raising gold will still be in progress on the Rand 100 years hence.

Turning for a moment to the history of electric power on the Rand, a few details will be of interest. Siemens and Halske were the first to obtain a concession in 1894, and formed the Rand Central Electric Works, Ltd., in 1895, which had a plant aggregating 3,200 kw. capacity in 1906.

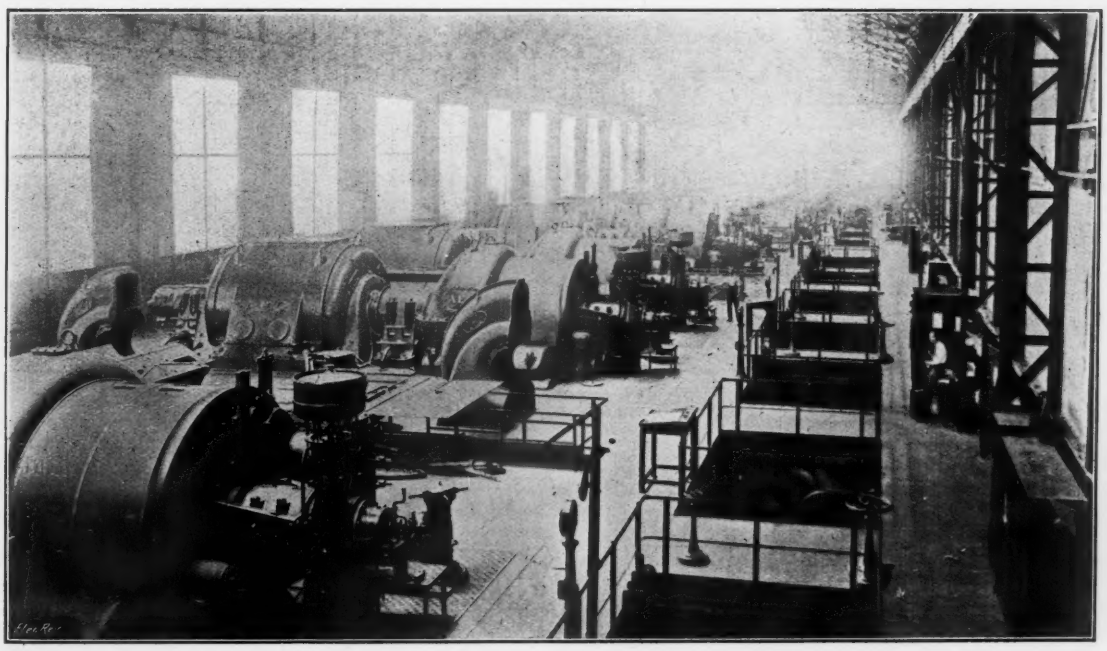


Fig. 2.—Engine Room at Rosherville Power Station.

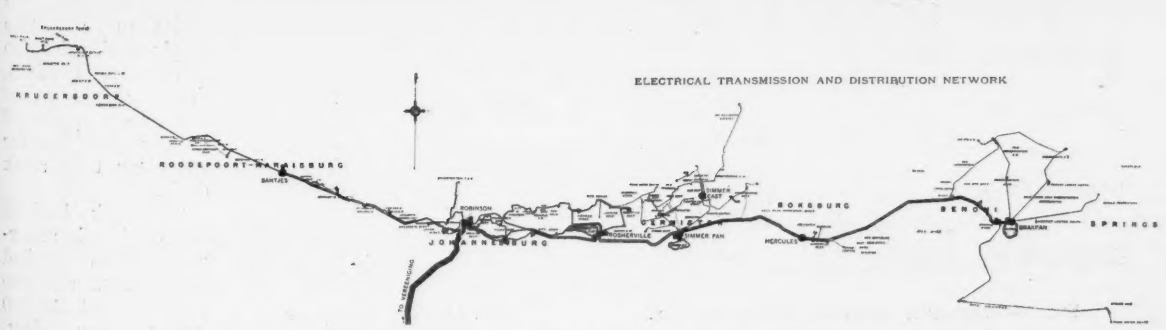


Fig. 3.—General Plan of Network of the Victoria Falls and Transvaal Power Co.

Another concession was obtained by the Simmer & Jack mine in 1897, from which the General Electric Power Co. was established in 1906 with plant having a capacity of 2,500 KW. In 1905 Messrs. Lewis & Marks, having in view the possibility of supplying the Rand from their coalfields at Vereeniging, 35 miles south, commenced obtaining wayleaves for a pole line, while certain European manufacturing companies sent out representatives to report on the prospects.

The Victoria Falls Co. ultimately took over the two existing supply companies in 1907, and purchased the Vereeniging wayleaves from Messrs. Lewis & Marks, at the same time entering into an agreement with them for the right to establish a power station at Vereeniging. In 1907, pending the installation of modern plant, a supply totalling 4,000 KW. was given from the existing steam stations which had been purchased.

As soon as it was appreciated that a cheap power supply was available the mining groups entered into contracts with the company, and the demands for power have since increased so quickly that it has throughout been the greatest difficulty for the company to raise capital and install plant rapidly enough to satisfy the demand.

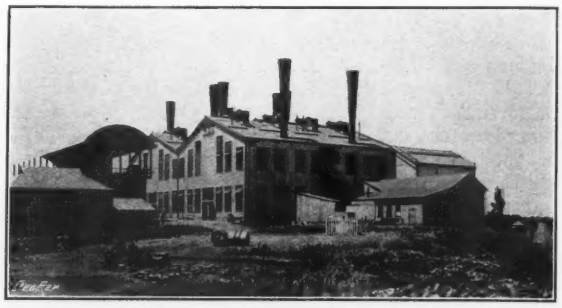


FIG. 4.—EXTERIOR OF GENERATING STATION AT SIMMER PAN.

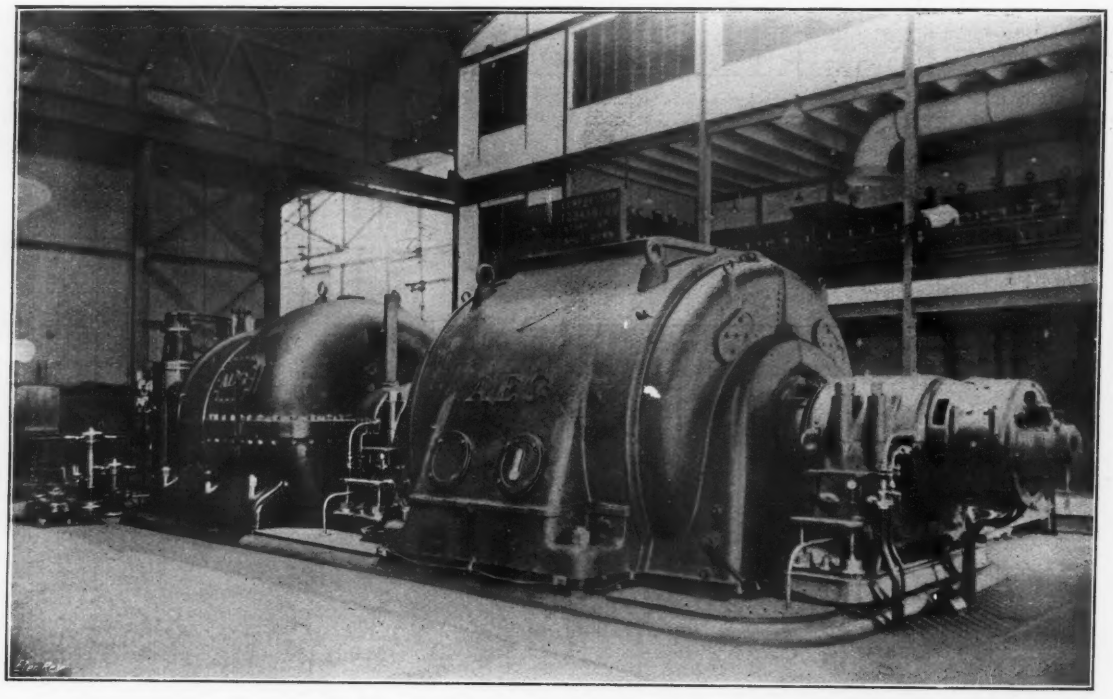


FIG. 5.—TURBO-GENERATOR OF 12,000 K.V.A.

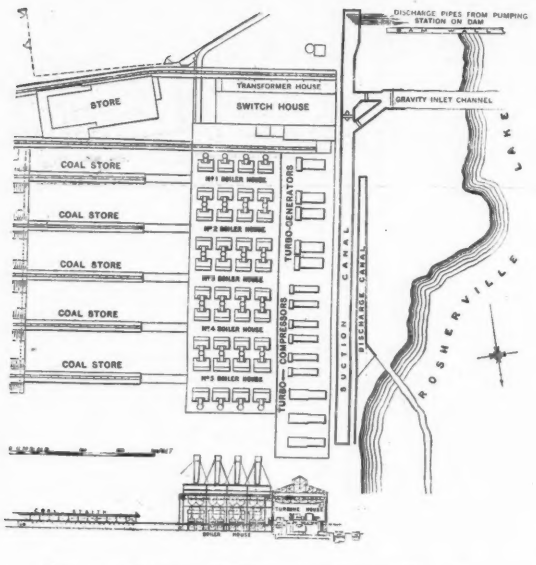


FIG. 6.—PLAN OF ROSHERVILLE POWER STATION.

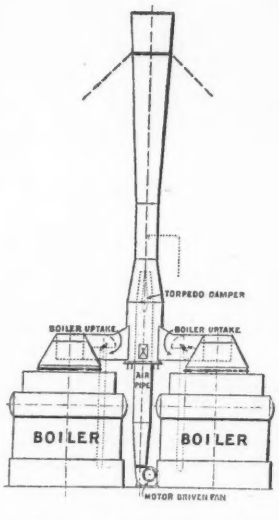


FIG. 7.—PRAT SYSTEM OF BOILER DRAUGHT.

In 1908 the largest group of mines, viz., that controlled by the Rand Mines, Ltd., and Messrs. Eckstein & Co., decided to change over their mines to electric driving. In addition to the supply of electricity to this group of mines, the conditions called for the supply of compressed air for working the rock drills.

The peak load of the combined undertaking has reached 88,000 KW., and the salesaverage 1,350,000 units per day.

These figures include the sales of compressed air to 10 mines. The air units represent practically the same amount of energy as if these 10 mines had converted their compressors to electric drive and purchased electricity. When the further demands for power which have already been notified are met by the plant now on order, the sales will reach 2,000,000 units daily. The monthly load factor, based on the hour of maximum output, varies from 70 to 74 per cent.

Name of station.	Total capacity of electric generating plant installed.	Steam driven air compressors installed.	Extensions in progress.
Brakpan ...	Two 3,000-KW. sets	—	—
Simmerpan ...	Six 3,000-KW. sets	—	—
Rosherville ...	Five 10,000-KW. sets	Six 3,500-KW. machines	Three 7,000-KW. steam-driven air compressors
Vereeniging ...	Four 10,000-KW. sets	—	—
Extensions in 1913.	—	—	Two 10,000-KW. sets
——	114,000 KW.	21,000 KW.	41,000 KW.

Total capacity of plant installed and in progress, 176,000 KW.

The supply is furnished to all mining consumers at 2,100 volts and 525 volts. The necessary step-down transformers and switchgear are provided by the power company, while the consumer supplies the sub-station building and pays the power company a sum equal to 2 per cent. of the power bill to cover the losses in the step-down transformers.

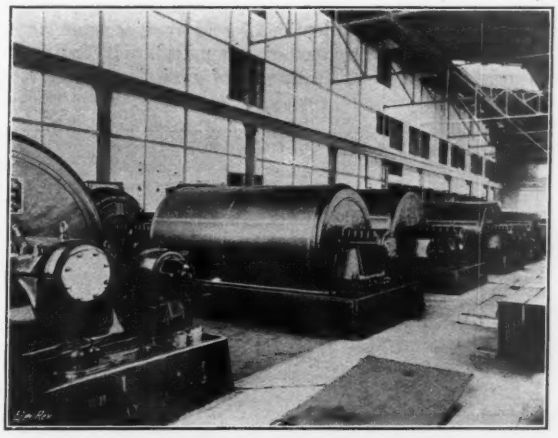


Fig. 8.—Air Compressors at Robinson Central Deep.

Fig. 9.—Interior of Simmer Pan Generating Station.

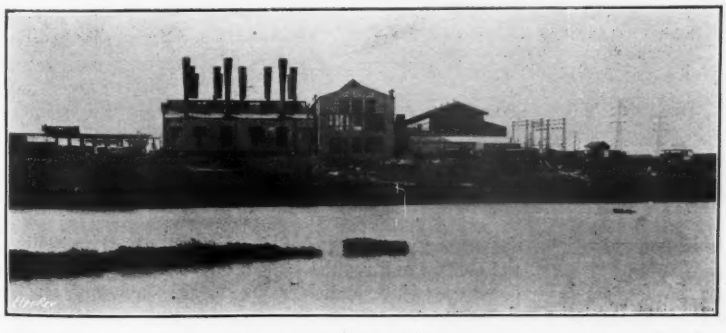


Fig. 10.—Exterior of Generating Station at Vereeniging.

The standard price in mining contracts covering not less than 12 years is 0·525d. per unit, as long as the monthly load-factor is above 70 per cent., the load-factor being based on the hour of maximum consumption. This price is subject to periodical revision depending upon the cost of production, and further, a participation with the consumers in the profits of the business after a due return has been paid on capital is also provided for. In case of failure of supply the consumers are

entitled to a payment from the power company of 7s. per hour for each 100-KW. put out of commission.

The introduction of these prices on the Rand has reduced the cost of power to the mines by 40 per cent., and has reduced the cost of production of gold by an amount varying from 6d. to 1s. per ton of ore milled. It has further resulted in considerable saving of capital expenditure on plant, which in the case of a new mine may amount to £100,000.

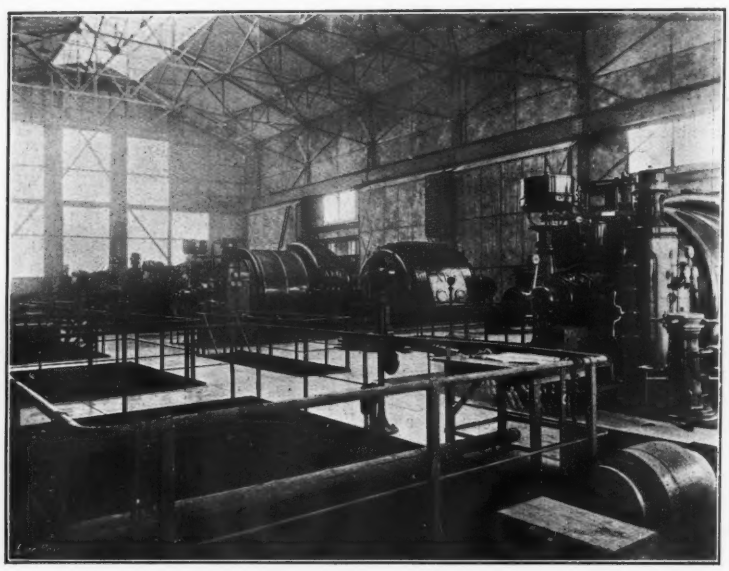


FIG. 11.—ENGINE ROOM AT VEREENIGING.

The area over which a power supply has to be given lies within a strip about two miles broad and stretching 50 miles from east to west. The total power used by the mines at the present time is estimated at about 400,000 H.P.

Power plants aggregating nearly 180,000 KW. have been installed in, or are under construction for, the stations enumerated in the table on page 521. They are set out in the order in which they were built.

At Robinson Central air station there are also six electrically-driven air compressors, each of 3,500-KW. capacity.

At all stations steam turbo-electric generating sets are employed, and produce three-phase energy at 50 cycles. Step-up transformers raise the generator pressure to 40,000, 20,000, or 10,000 volts, and their interposition gives additional security to the machines against pressure rises. This method, in which the generator voltage is optional, gives the further advantage of enabling the stators to be constructed with bar winding having one bar per slot.

The main system of transmission (shown in fig. 3) is effected by means of 40,000-volt overhead lines stretching practically the whole length of the reef. At the present time, however, the western extremity is working as a 20,000-volt distribution line. Where the load is most dense the transmission system consists of two rows of towers, each arranged to carry two circuits (fig. 19, p. 524).

The 40,000-volt transmission system is fed at Brakpan, Simmer Pan, Rosherville, and at Robinson Central, where the supply from the Vereeniging station joins the reef. In addition to these distribution stations the transmission lines pass through two further distributing centres at Hercules to the east and Bantjes to the west. From these six points distribution networks, laid out as ring mains, supply the various sub-stations on the mines. The three eastern distribution stations supply the system through 10,000-volt overhead lines. The central portion of the area is served by an underground 20,000-volt cable system.

The Vereeniging station is connected to the Rand by an 80,000-volt line approximately 35 miles long, terminating at the Robinson Central distribution station, where the pressure is transformed to either 40,000 or 20,000 volts, these pressures being also coupled together through transformers aggregating 16,000 K.V.A.

All transmission and distribution circuits, with the exception of the long-distance 80,000-volt lines, are equipped with the Merz-Price balanced relay system for automatic switch control, without which a reliable supply on the ring-main system could not have been given, and the more expensive radial type of network would have been necessitated. This balanced relay system is also employed for the protection of all transformers and for the large generators. The pilot wires for operating this system on the 40,000-volt transmission lines are combined with telephone circuits in a lead-covered cable suspended overhead, while on all distribution networks (both overhead and underground) combined pilot and telephone cables are laid underground.

A special feature of the lay-out of the telephone system is the arrangement whereby the control of all switching and the control and regulation of load, voltage, power factor, and other operating conditions, are in the hands of the control department.

One control engineer or load dispatcher is responsible for all routine switching and linking carried out at any point

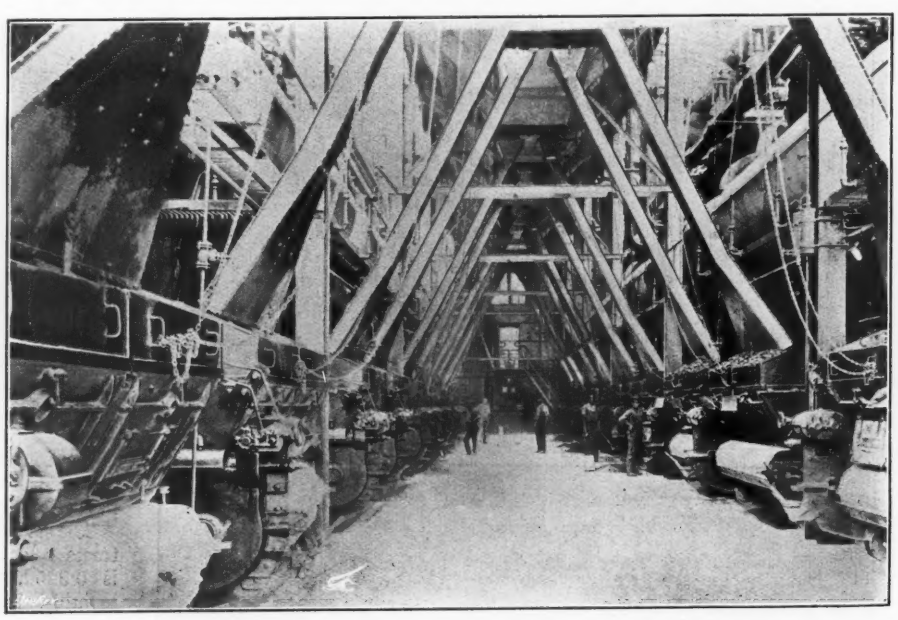


FIG. 12.—BABCOCK & WILCOX BOILERS (MARINE TYPE) AT VEREENIGING.

on the electrical system during his shift, and under the regulations no switching can be carried out without his consent. The load dispatcher, as soon as any switching has been carried out, adjusts a large diagram in the control room so that it shows every connection on the system (fig. 17, p. 524).

When the contract with the Rand Mines, Ltd., was concluded the site for the station was selected at the Rosherville Dam, which is the largest lake on the Rand. This station will shortly have a capacity of nearly 100,000 KW. of plant installed. After the new extensions are completed the turbine room will be 450 ft. long and 75 ft. wide, and there

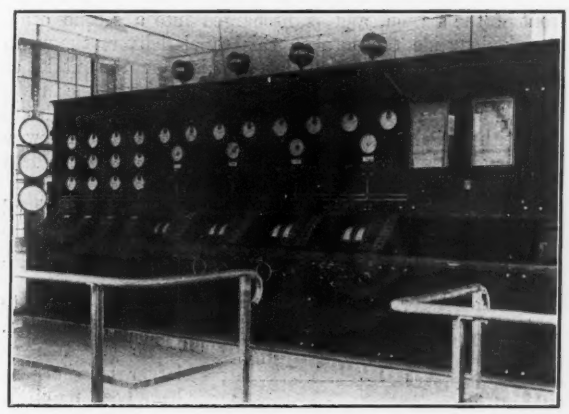


FIG. 13.—CONTROL BOARD, VEREENIGING POWER STATION.

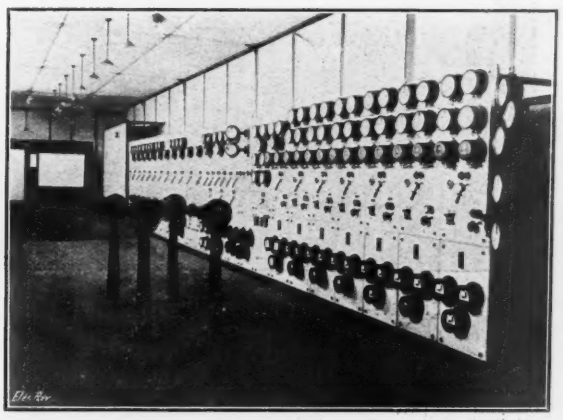


FIG. 14.—CONTROL BOARD, SIMMER PAN POWER STATION.

will be five right-angle boiler bays, each containing eight boilers. The general lay-out is shown in fig. 6, p. 520.

The coal-storage arrangements are very complete, the coal being discharged from a height of 14 ft. through the floors of 40-ton railway trucks into outside storage bunkers, under which coal conveyors are arranged. The whole structure is open, as roofing is unnecessary, owing to the favourable climatic conditions.

The conveyors, each capable of dealing with 40 tons of coal per hour, run in tunnels under the external coal store, and are fed with coal by gravity through shoots from the coal pile above. These conveyors are kept running practically continuously, allowing the internal coal bunkers in

FIG. 15.—BUS-BAR GALLERY.

the boiler house to be of small capacity. An automatic tip is fitted over the bunkers, which tips the conveyor buckets when the coal in any particular bunker has fallen below a certain level. Weighing machines are installed in the conveyor tunnels, and the coal is weighed as it passes in the conveyor buckets.

The ashes are discharged from the rear of the stokers into hand trucks in the basement, where natives push the loaded trucks out and attach them to a motor-operated rope haulage leading to the ash dump. The question of removing these ashes by suction is at present under consideration.

The class of coal burnt at this and other Rand stations is mostly the small coal from the collieries in the Middelburg district 60 miles distant, mixed with a proportion of the duff produced by the coal-cutters. The coal has an average calorific value of about 11,000 B.TH.U. per lb.

The large percentage of ash, viz., 18 to 25 per cent. of the coal, and the high load factor at which the plant is operated, necessitated a combination of boiler, superheater and economiser that would give the highest possible efficiency; the high cost of white labour, and the inefficiency of that of the native, also required that the plant should be mechanically operated.

In view of these considerations, and the great cost of constructional work in South Africa, the injector system of induced draught (fig. 7) originally devised by Mr. Prat has been adopted in all the power stations. The system has been found to give the utmost satisfaction.

In the lay-out employed, adjacent boiler units are connected to a common ejector chimney, the top of which is 90 ft. above the boiler-house floor. An electrically-driven rotary fan, capable of developing 75 H.P., blows cold air through the ejector situated in the chimney, thereby pro-

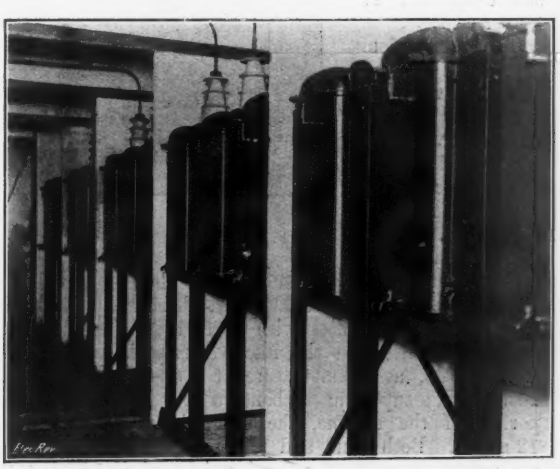


FIG. 16.—SWITCH GALLERY.

ducing the necessary suction in the flues, and a draught of about 1 in. is usually employed.

With this arrangement great flexibility in the boiler house is obtained, and by the use of a torpedo-shaped damper in the air pipe regulating the pressure of the air jet, the duty of the boiler unit can be easily regulated to suit fluctuations in the load. The plant is absolutely smokeless, and it is difficult by looking at the ejector chimneys from outside the station to tell which boilers are at work.

The boiler unit selected is the Babcock & Wilcox marine type, fitted with chain-grate stokers, each having an integral superheater and economiser. The boilers are arranged in

two rows in each boiler house, with a central and common firing floor (fig. 12, p. 522). Each boiler has a rated capacity of 32,000 lb. of steam per hour at a pressure of 220 lb.

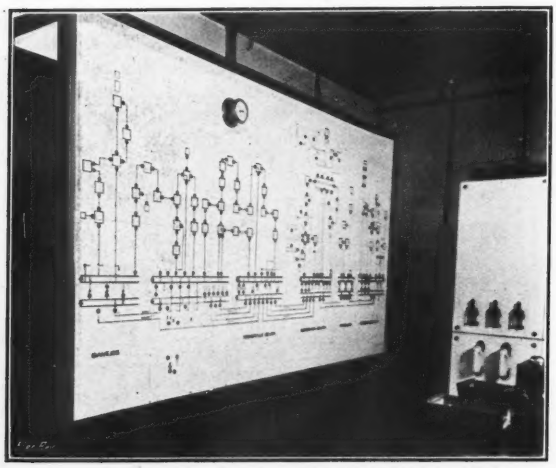


Fig. 17.—Load Dispatcher's Diagram.

with a temperature of feed water of 100° F., and is capable of producing 38,000 lb. of steam without undue forcing. The heating surface of the boiler is 5,520 sq. ft., of the superheater 1,720 sq. ft., and of the economiser 2,200 sq. ft. A six-hour test on one of the boiler units gave a combined efficiency of boiler, superheater, and economiser, of 80 per cent.

The turbine room (fig. 2) at present contains five turbo-generators each of 12,000 K.V.A. (fig. 5), and six steam compressors each having an input of 3,500 KW.; three more steam compressors each taking 7,030 KW. are also being installed. The turbines are of the A.E.G.-Curtis horizontal type, having one high-pressure wheel with three rims of blades. The admission pressure at the intake nozzles is brought down from 220 lb. at a temperature of 300°—350° C. to about 20 lb. with a superheat of about 20° C. In the low-pressure portion of the turbine, the steam is expanded through 12 stages. Both hand and motor regulation of the speed are arranged for. The total weight of a 12,000-K.V.A. turbine set, including condenser and pumps, is 370 tons.

The stators of each of the six-pole generators are bar wound, having one bar per slot. The machines running at 1,000 R.P.M. produce 50-cycle three-phase energy at 5,000 volts, which is stepped up to either 10,000, 20,000, or 40,000 volts, by transformers directly connected with the stator terminals.

The rotor coils are lined with metal casings before being attached to the rotor by dovetailed grooves and wedges. The rotor carries a ventilating fan at each end. The frequent dust storms in South Africa charge the air with heavy particles which might prove dangerous in the ventilation of the machines, consequently each machine is provided with an air filter having an effective surface of fireproof cloth of 8,000 sq. ft. Each turbine set is provided with a direct-driven exciter, while a stand-by supply is also available from a motor-generator and battery.

The condensers have a cooling surface of 17,750 sq. ft.; each set has a centrifugal circulating pump of about 663,000 gallons per hour capacity, and a centrifugal air pump, both connected on one shaft and driven direct by a steam turbine. The exhaust from the auxiliary turbine is taken to the middle stage of the main turbine, where the remaining energy in the steam is utilised down to the vacuum of the condenser.

The water for the condensers and compressor jackets is taken from the lake through a channel excavated along the front of the station, and is discharged into a second canal placed alongside the intake; this canal delivers the warm water to the lake at a point as far from the intake as possible. Under normal conditions of water levels the intake water flows by gravity into the service canal, but in order to deal with periods when the water in the lake may be low, a pumping station has been erected half-way along the dam wall at the deepest part of the lake.

The boiler feed pumps are of the turbine-driven centrifugal type, and are installed in the turbine room. With the exception of certain electrically-driven bearing-cooling pumps, all auxiliaries are turbine-driven.

The generator transformers are connected by cables to their corresponding generators, and are each of 12,500-K.V.A. capacity. Where larger transformers have been required, as for the last two sets at Vereeniging, two transformers for each machine have been installed. The transformers at Rosherville are of the shell type and water-cooled, the windings nearest the terminals being specially insulated to withstand between adjacent turns a pressure of 25,000 volts for 5 minutes. A test pressure of 160,000 volts was applied to the whole of the windings. The weight of each transformer complete, without oil, is 50 tons; the oil itself weighs 21 tons.

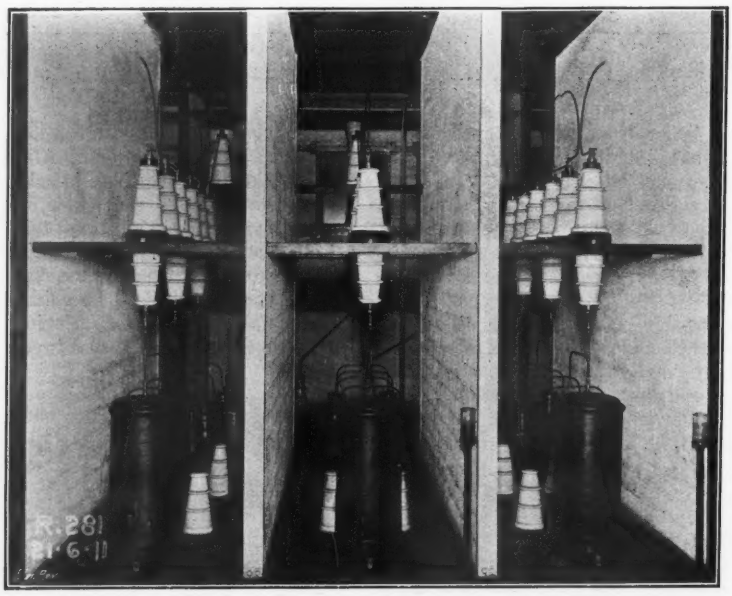


Fig. 18.—Lightning Arresters at Rosherville.

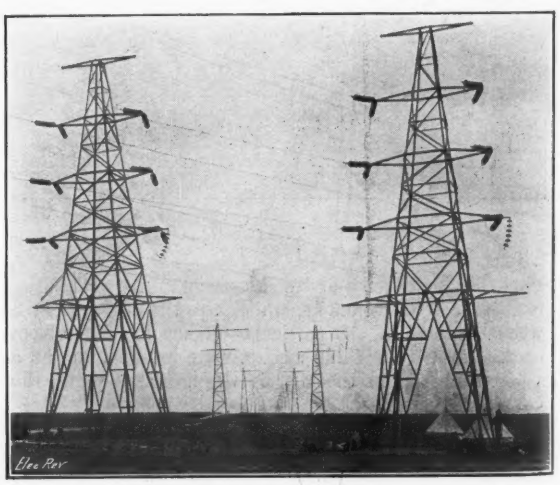


Fig. 19.—Double Tower Line at 80,000 volts, and Construction Camp.

The steam turbo-compressors at Rosherville are similar to the motor-driven compressors at Robinson Central, and are each designed to deal with 22,000 cb. ft. of free air per minute with an outlet pressure of 9 atmospheres (absolute). The power required on the shaft is, roughly, 3,500 KW. In the case of electrically-driven sets at Robinson Central each unit is divided into two halves on separate shafts, each motor having a capacity of about 2,000 K.V.A., and being designed to operate at full load at a leading power factor of 85 per cent. The sets run at 3,000 R.P.M. The steam-driven compressors are arranged in two sections on the same shaft, with an intercooler between them. The cooling water required for the jackets of the compressor and intercooler amounts to about 40,000 gallons per hour. The air leaves the compressor at a temperature of about 70° C.

Between the compressor and the pipe line an automatic non-return valve is fitted, which allows a compressor to drop out to atmosphere when its pressure falls below that of the air system.

By the use of the rotary compressors the air entering the pipe system is kept entirely free from oil and other impurities liable to be introduced into the air system when piston compressors are employed. The speed regulation of the steam turbo-compressors is automatically controlled by the pressure in the air pipes. The regulation of the electrically-driven compressors at Robinson Central is effected by throttling the intake. The weight of a turbine-driven compressor, condenser, and pumps is 180 tons.

The switchgear is laid out in a building at the southern end of the station, and the step-up transformers are in cubicles arranged along the outer side of the switch-house. The last-mentioned is constructed with four floors: the upper floor contains the lightning-arrester gear, the third floor the bus-bars, the second floor the 40,000 and 20,000-volt oil switches, whilst the lower floor is occupied with cableways and pipe passages. Duplicate bus-bars are installed for both the 40,000 and 20,000-volt systems, the various oil switches being provided with knife selector switches to connect to either bus-bar. The 40,000 and 20,000-volt systems are connected together through coupling transformers. The switches consist of three single-phase coupled switches operated from a remote-control board (see figs. 13-16).

Since the Rosherville station came into commercial service, troubles have been experienced owing to failures of switches on short-circuit. When the Brakpan and Simmerpan stations were started to supply the 40,000-volt transmission and also the 10,000-volt local lines, their total capacity was 24,000 KW., and no trouble was experienced when a short-circuit occurred on the system. When, by the addition of Rosherville, the system grew to 60,000 and 70,000-KW. capacity, switch breakdowns occurred, conclusively proving that no apparatus was available which could be relied upon to interrupt the immense rush of current occurring on short-circuit.

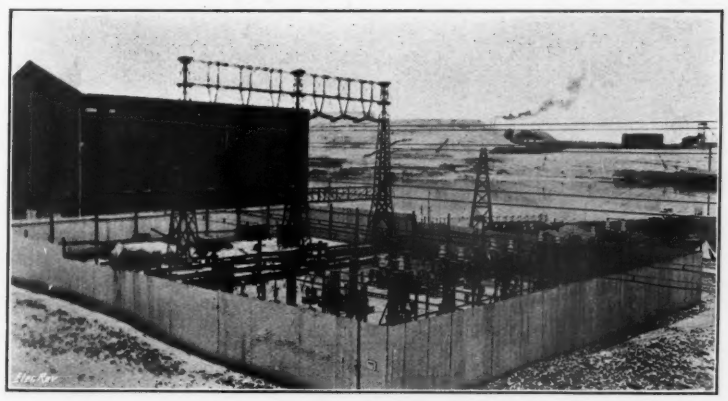


FIG. 20.—LIGHTNING ARRESTERS, &C., AT END OF 80,000-VOLT LINE.

Some serious line interruptions have in the past been caused by the wilful throwing of bare wires over the lines. When this form of short-circuit has occurred near a power station, apparatus has usually been lost.

Dynamos running at a high speed have a low internal reactance. The step-down transformers in the present case were designed with a low reactance to give good regulation, so that probably the total reactance in circuit on a short-circuit was about 7 or 8 per cent. The momentary rush of energy on short-circuit could therefore reach the tremendous proportions of 500,000—700,000 KW. No oil switch, as at present designed, could interrupt this rush of power unassisted. The intensely hot gases formed by the arc, after rising through the oil, come into contact with the air and cause an explosion, which, more often than not, is productive of a switch failure.

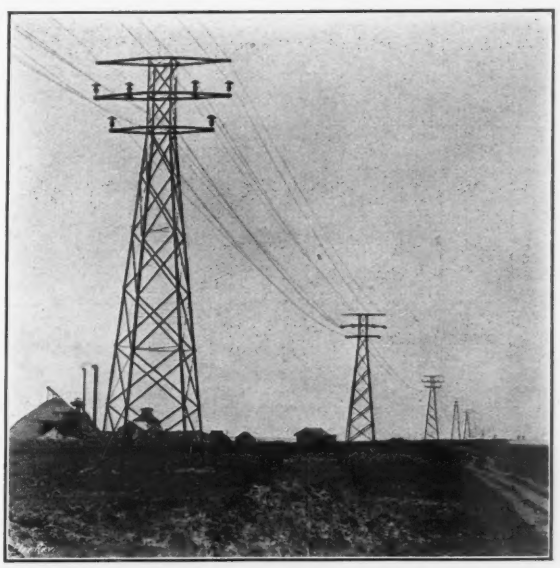


FIG. 21.—OVERHEAD LINE AT 40,000 VOLTS.

About the time that this trouble became apparent on the Rand, exactly the same difficulty was being experienced on stations of similar large output in America, and the problem was vigorously tackled over there. Many methods have been tried at Niagara, Chicago, and other places, and it has become generally recognised that it is necessary to insert additional reactances in order to limit the rush of energy on short-circuit. In certain cases this precaution has proved entirely satisfactory. In others additional methods for assisting the oil switch have been necessary; such as (1) sectionalising the system on to separate bus-bars and limiting the amount of machinery that would be affected by one short-circuit; (2) the placing of two switches in series timed so that one opens first and inserts a non-inductive resistance, the circuit being actually broken by the second switch; (3) the use of a special type of switch having two moving systems, one of which first introduces reactances, and the other then breaks the circuit.

These methods have been tried on the Rand. The earthing of the neutral through a resistance has proved most valuable, as more than 90 per cent. of the faults start as faults to earth. At Rosherville and Vereeniging reactances having a value of about 6 per cent. have been installed between the dynamos and the step-up transformers. The latest practice is to design both generators and transformers required for power service with large internal reactances.

At Vereeniging and at the Rand end of the 80,000-volt line two systems of switching have been installed. On the first two Vereeniging machines two switches are employed in series, one introducing a non-inductive resistance; while on the last two machines, both of which have not yet been put into service, a two-movement reactance switch is being

installed. This switch is constructed on the lines of an oil-break switch, but is provided with a second pair of contacts

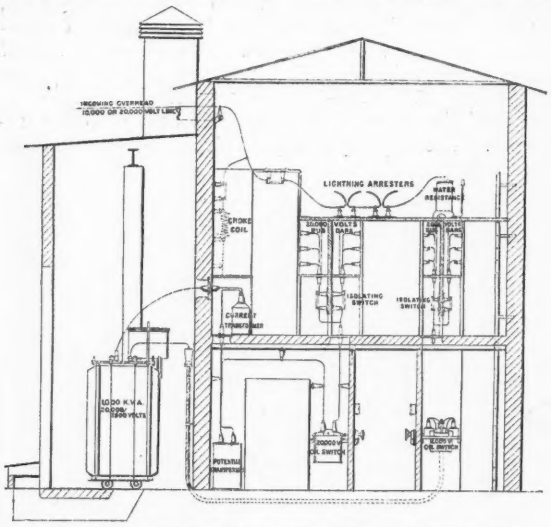


FIG. 22.—SECTION OF STANDARD TYPE OF CONSUMERS' SUB-STATION.

for the final break. The separation of the first pair of contacts introduces two reactances placed centrally one on each terminal bushing inside the oil tank, and the second pair of contacts finally breaks the circuit.

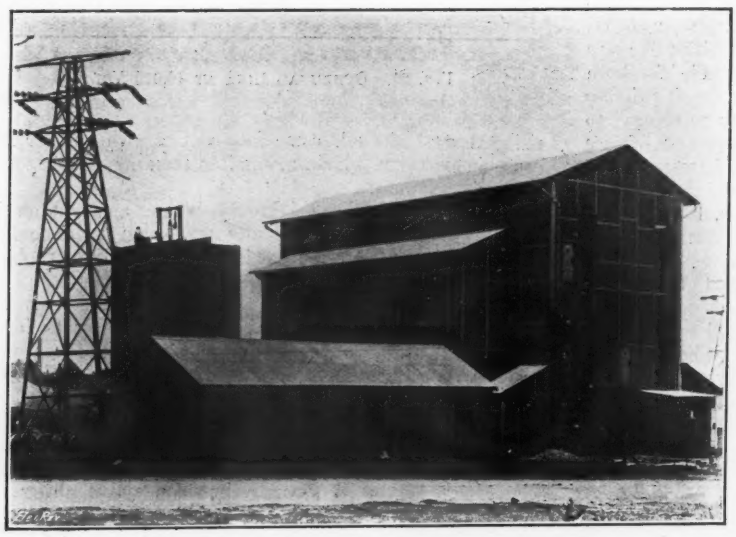


FIG. 23.—DISTRIBUTION STATION AT BANTJES FED FROM 40,000-VOLT OVERHEAD LINE.

At some early date the system will also be sectionalised in order to reduce the rush of power on short-circuit, and in doing so reactances of relatively large value can be inserted between sections in those cases where it is not economical to separate adjacent sections permanently.

This problem of switchgear for dealing with enormous rushes of power has proved one of the most difficult that has been encountered so far on the Rand and also in America. It has not yet been finally solved, nor have switches been standardised which are capable of dealing unassisted with these exceptionally severe service conditions. These remarks on switchgear apply not only to the central stations, but also to the distribution stations, and in a less degree to the consumers' sub-stations.

The electrical supply at 2,000 volts and 550 volts to the consumers' premises is effected from step-down transformer stations, which are built by the consumers, but are equipped with switchgear and transformers by the power company (fig. 22). There are 60 of these consumers' sub-stations connected to the system, and their individual capacity varies from 10,000 K.V.A. to 2,000 K.V.A., the normal size being 5,000 K.V.A.

The standard sizes of consumers' transformers are 1,000, 500 and 250 K.V.A., designed with the primary windings arranged for either 20,000 or 10,000 volts. A temperature rise of 40° C. is allowed above an air temperature of 40° C. The windings near the outgoing terminals will stand a pressure of 15,000 volts between adjacent turns. The high-tension windings are tested to the secondary windings and core with a pressure of 40,000 volts, and the insulators with 60,000 volts. The transformers have been supplied by Messrs. Siemens, the Allgemeine Elektricitäts Gesellschaft, and the Westinghouse Co.

The transformers are exported filled with oil, thereby reducing the cost of transport and dispensing with the necessity of drying out after erection. In order to allow for the expansion and contraction of the oil each transformer tank is connected with a second smaller tank fixed on the wall of the sub-station. This expansion tank is fitted with a vertical vent-pipe, so that only a small surface of oil is in contact with the air, and by this means sludging is prevented. Each sub-station chamber has a short stack, which induces a natural draught and provides effectual ventilation. Double bus-bars are provided for each voltage. The high-tension and low-tension switchgear in each sub-station is arranged in different chambers with a central operating passage between containing no "live" material. The "live" chambers are locked, and stringent regulations as to the possession of the keys ensure that no unauthorised person can obtain access; in no case is one man allowed to enter alone. The total capacity of the transformers in operation, including generator transformers and coupling transformers, is unusually large, amounting at the present time to 450,000 K.V.A.; but this will be increased to 508,600 K.V.A. when the transformers delivered and on order are brought into commission.

The company realise the importance of welfare work and its influence on the conditions of the life of the staff. They give a generous support to recreation and sport, and facilitate in every way the promotion of social intercourse among all classes of the employés.

Some 60 residences and quarters have been built by the company at the various power stations, and at each station a boarding house and recreation rooms are provided. Generally speaking, the conditions of life compare very favourably with those of an engineer on the mines. A fleet of 14 motor-cars is maintained in constant service for the use of those officers and engineers of the company whose duties necessitate visiting the different parts of the system. A special department handles the entire transport of materials, and employs constantly two motor-lorries and 50 mules and horses.

FIG. 24.—SUB-STATION FED WITH UNDERGROUND MAINS.

[Further extracts from the paper will be found under "Proceedings of Institutions," page 538.]

NOTES.

(*Continued from page* 518.)

Institution and Lecture Notes.—Concrete Institute.—On Thursday, March 13th, a paper was read by Mr. H. C. Johnson, on "The Strength of Cement; Results of Tests on 15 different Brands used in Paste, Mortar and Concrete."

Institution of Electrical Engineers (Western Section).—The annual meeting of the Section was held on March 10th, at the South Wales Engineers' Institute, Cardiff, Mr. W. A. Chamen presiding. The chairman reviewed at length the work carried out by the Section since its inauguration in March last year, and expressed gratification at the increase in the roll of membership. He congratulated the Section upon its new chairman (Mr. H. Faraday Proctor), and its vice-chairman (Mr. D. E. Roberts, Cardiff). The chairman announced that Mr. Arthur Ellis, Cardiff, had had to resign his seat. The following were elected on the Committee:—Messrs. H. D. Munro, A. J. Newman, E. G. Okell, A. B. Randall, Prof. D. Robertson, W. A. Scott, F. Tremain. After the general meeting, a discussion on Mr. Sydney F. Walker's paper on the use of "High-tension Continuous Current on the Thury System in Mines," was held. Owing to the absence of the author through ill-health, the secretary (Mr. Sidney B. Haslam) read an abstract on his behalf, and after further remarks from the chairman, the discussion was adjourned until a special meeting to be held on April 14th, in Cardiff.

(Yorkshire Section).—On Wednesday, an informal paper by Mr. Thos. Roles on "Electric Heating and Cooking" was read at Sheffield. A discussion followed.

Royal Institution.—The following arrangements are announced:—

Fridays.—

April 4th, at 9 p.m.—"The Spectroscope in Organic Chemistry," by Dr. J. J. Dobbie, F.R.S.

April 18th, at 9 p.m.—"Applications of Polarised Light (with experiments)," by Dr. T. Martin Lowry, F.R.S.

May 23rd, at 9 p.m.—"The Secret of the Permanent Magnet," by Prof. S. P. Thompson, F.R.S.

June 6th, at 9 p.m.—"Reflection and Refraction of Light as Concealing and Revealing Factors in Sub-Aquatic Life," by Dr. Francis Ward.

Thursday Afternoon Lectures.

May 22nd and 29th and June 5th, at 3 o'clock.—Three lectures by Prof. W. J. Pope, F.R.S., on "Recent Chemical Advances: (1) Molecular Architecture; (2) Chemistry in Space; (3) The Structure of Crystals"—experimentally illustrated.

Saturday Lectures.—

May 10th and 17th.—Two lectures by Mr. H. A. Humphrey on "Humphrey Internal-Combustion Pumps."

May 24th, 31st, and June 7th.—Three "Tyndall" lectures by Prof. E. Rutherford on "Radioactivity": (1) The Alpha Rays and their Connection with the Transformations; (2) The Origin of the Beta and Gamma Rays and the Connection Between Them; (3) The Radio-Active State of the Earth and Atmosphere.

Electric Stoves for Canada.—H.M. Trade Commissioner for Canada reports that a firm in Winnipeg is desirous of getting into communication with United Kingdom manufacturers of electric stoves who may wish to do business in Winnipeg and the surrounding districts.—*Board of Trade Journal.*

New Hydro-Electric Works in Italy.—Several important schemes are proposed to be carried out in the near future. In the first place, a Government concession is shortly to be granted to the Società per le Forze Idrauliche della Sila, which is an investigation company formed by the Banca Commerciale, the Italian Southern Railway, the Società Meridionale di Elettricità, and the Société Franco-Suisse of Geneva. The concession relates to the construction of dams and hydro-electric works in the Sila mountain range, where there are heavy rainfalls, followed by periods of drought, so that the water falls very irregularly. It is proposed to construct four dams eventually, of which two are to be built at first, and the total power available is estimated at 150,000 H.P. As, however, no demand exists for such a large amount of power in this thinly populated district, which has few industries, the company intends first to proceed with plant of 50,000 H.P., and the energy will be used partly for the local production of carbide of calcium and partly for distribution over Calabria, Basilikata, and a portion of Apulia, by means of a network about 200 miles in length. The capital required for this provisional scheme ranges from £1,600,000 to £2,000,000, and it will be raised by the four promoting companies previously mentioned. A feature of the scheme is that by the adoption of a suitably arranged hydraulic system it will be possible to protect the districts at the foot of the mountain from drought on the one hand, and inundations on the other. A second project refers to Sardinia, where a hydro-electric proposal is also associated with an improvement in the agricultural land. It is intended to dam the River Tirso, and a yield of 15,000 H.P. is expected. The power is to be utilised in the local mines, and the water will be also used for the purposes of irrigation. The expenditure will be defrayed partly by the State and partly by other interests. A third scheme is that of the Società Ligure Toscana di Elettricità, of Leghorn, which is erecting a new power station of 15,000 H.P. on the Serchio River, in the Ligurian Apennines. The supply will be extended to Pistoia and Florence, and the cost of the new station is to be provided for by raising the company's capital from £450,000 to £640,000.

The Siemens Smoker.—The King's Hall at the Holborn Restaurant was well filled on Wednesday, March 19th, on the occasion of the Siemens smoking concert, to which we made preliminary reference in our issue of February 28th. Mr. Alexander Siemens was in the chair, and gave words of welcome to the very large number of friends of the Siemens companies who were privileged to enjoy the excellent entertainment and to partake of the hospitality which had been prepared. The artistes were as follows: Miss Annie Bartle, soprano; Miss Olive Fox, comedienne at the piano; Mr. Ivor Walters, tenor; Mr. Thomas Howell, baritone; Mr. Olly Oakley, banjoist; Mr. Bromley Carter, humorist; Mr. Will Edwards, humorist; Mr. Ernest Hastings, musical sketches; Mr. Jock Walker, Scotch humorist. Mr. Mansell Stevens was accompanist, and Mr. George Lakeman acted as musical director. Mr Harry Gooding's Imperial Orchestra played a number of selections from 7.30 until 8 o'clock, and also during the interval. The event was declared by all to have been a huge success.

Parliamentary.—Electric Light Plant Contract.—In the House of Commons, March 17th, Mr. Touche asked the representative of the First Commissioner of Works to state where the contract for the equipment of the British Legation in Pekin with electric generating plant, ice-making plant and other things was placed, and if he would state the amount of the contract and whether it was given to a German firm. Mr. Benn replied that the contract in question was placed amongst British firms, with Messrs. Siemens Bros. & Co., Ltd., of Caxton House, Westminster. The amount of the contract was £11,572 10s.—Further questioned by Mr. Touche as to whether the hon. member was aware that Messrs. Siemens Bros. was a purely German firm, Mr. Benn said that on the contrary, the firm was a British one.

Second Readings.—In the House of Commons on March 17th, the following were read a second time:—Chesterfield Corporation Railless Traction Bill, and Cleveland and Durham County Electric Power Bill.

I.E.E. Students' Electric Dinner.—The informal Electric Dinner held by the I.E.E. Students last Friday evening, in the West Room of Tricity House, was an unprecedented success. The attendance numbered nearly 60, the West Room being packed to its utmost capacity. Among the toasts may be mentioned those of "Electric Cooking" and "Point-Five Juice." The former was proposed in a very breezy speech by Mr. S. M. Hills (the author of a recent Students' Section paper on "Electrical Heating and Cooking Apparatus"), and Mr. C. H. Smith, of Marylebone, responded in a more technical vein. The latter was proposed by Mr. G. W. P. Page, and received a humorous response by Mr. J. Mould. Between the toasts Messrs. S. G. Killingback, R. E. Dickinson, W. V. Zolmer, and H. K. Whitehorn contributed items to the musical programme with much success. On the whole, the chairman, Mr. J. C. Rennie, is to be heartily congratulated upon the great success which attended the first All-Electric Dinner of the I.E.E. Students.

South America.—According to *La Electricidad*, of Buenos Ayres, activity in electric enterprise is very great in all that section of South America. The municipality of Anchorena, in the province of San Luis, has decided to establish an electric lighting service. The civic authorities of La Paz, in the province of Entre Rios, are similarly disposed, and the Comision de Fomento, of Carcarana, in the province of San Lorenzo, was considering tenders for the installation of an electric light and power service on March 8th, while in the province of Buenos Ayres the authorities of Pilar have begun the preliminaries for the introduction of the modern illuminant, and the installation at Trenque Lauquen is expected to be completed in the course of a month or two. A start has also been made with the installation at Pico. As will already have been seen from our "Contracts Open" column, in the Federal capital the Minas, Geologia and Hidrologia Department of the Ministry of Agriculture is inviting tenders for motors, cables, dynamos and accessories for a power installation. Furthermore, according to the same journal, Herr Mauro Herlitzka, of the firm of the same name, has returned to South America, having secured capital for new and important electrical schemes.

Appointments Vacant.—Meter tester-repairer (30s.), and switchboard attendant (25s.), for the Harrow Electric Light and Power Co., Ltd.; arc lamp trimmer, jointer and meter fixer, for the Stoke-on-Trent Corporation; charge engineer for the Burgh Electricity Department, Paisley; mains superintendent for the Islington B.C. Electricity Department (£200). See our advertisement pages in this issue.

Illuminating Engineering.—An exhibition of the latest improvements in electric illumination and other devices was held in Newcastle-on-Tyne on 17th inst., having been organised by the British Thomson-Houston Co., of Rugby. The object of the show, as described by Mr. H. C. Wheat, the company's illuminating engineer, was to illustrate the fact that many existing installations are deficient and lacking in hygienic principles, and that a common failure to get better results is due to the fact that so few persons understand the proper method of utilising reflectors. Demonstrations were given to show the increased efficiency obtained by the proper use of reflectors. In the evening Mr. Wheat delivered a lecture on "Illuminating Engineering," which was illustrated by lantern slides.

Inquiry.—A correspondent inquires for the makers of a substitute for slate known as "Sindanyo Asbestos Wood."

Annual Dinner.—The fifth annual Staff Dinner of the South Metropolitan Electric Light and Power Co., Ltd., was held on 19th inst. at the Trafalgar Hotel, East Greenwich, the chair being taken by the managing director and engineer-in-chief, Mr. Henry W. Bowden. After the usual toasts of "The King" and "The Company" had been duly honoured, and the chairman had given a brief *résumé* of the year's work of the company, the evening was concluded with a social programme and whist drive.

Fatality.—A correspondent states that George Cochrane, electrical engine-man, at Calderbank Colliery, Uddingston, who took great delight in having flowers and plants in his engine house, was setting a window box in position, when he fell over a stair-rail and was killed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—There was quite a lengthy discussion at the Carlisle Town Council meeting, when the proposal to fix the salary of a successor to Mr. S. T. Allen, the electrical engineer (who goes to Wolverhampton), at £500, he to be debarred from private practice and from taking pupils, was forward. There were two amendments moved by parties who thought the amount too large for a commencing salary, £350 and £400 being favoured. The original recommendation was a unanimous one on the part of the Electric Lighting Committee, but the Council meeting was markedly divided on the amendments, there being 10 in favour of £400 and 15 against. Eventually the recommendation was adopted. In the course of the discussion, high praise was given to Mr. Allen for the manner in which he had brought the undertaking from a non-paying to a paying condition by reason of his great business aptitude and engineering skill. The speaker said that had they been a private undertaking, they would not have let him go without offering him £1,000 per annum. His salary of £600 had only been a commencing one and he had been promised a long way beyond that figure. With the exception of the appointment of the Town Clerk, this was the most intricate appointment of the City.

The *Australian Mining Standard* says that Mr. W. H. Vincent, who has been electrical engineer in the works branch of the Home Affairs Department, Melbourne, at £350 a year, has been appointed chief electrical engineer to the Brisbane Electric Light Co., at £600 a year.

Mr. E. G. Baker, mains assistant to the Tynemouth undertaking, has been appointed to a similar position with the Motherwell Corporation.

The Stoke Newington B.C. has approved of the salary of Mr. S. Hann, electrical engineer, being advanced by £20. Councillor Lavey said that the electricity department was increasing by leaps and bounds. Mr. Hann had saved the Council much money since it had dispensed with the services of the consulting engineer.

On the occasion of his departure to take up a position at Swansea, Mr. J. A. Somerville, for five years on the staff of the Lewes and District Electric Supply Co., has been presented by his colleagues with a case of pipes.

A recommendation by the Electricity Committee of the Norwich T.C. to increase the salary of the city electrical engineer, Mr. F. M. Long, from £600 to £700 per annum, has been referred to the General Purposes Committee.

The Gloucester City Council has increased the salary of its electrical engineer, Mr. F. H. Corson, from £350 to £400 per annum, and granted him permission to take one pupil.

Mr. J. A. McKinney has left the Cleveland and Durham Electric Power, Ltd., to take up an appointment as relief shift engineer on the Kent Electric Power Co.

Tramway Officials.—Mr. Thos. Ridyard, for six years with the Manchester Corporation tramways department, has been appointed rolling stock superintendent to the Liverpool Corporation tramways at a commencing salary of £350 a year.

Amongst a large number of increases to Corporation officials at Manchester, sanctioned at a meeting of the City Council last week, were the following:—Tramways department—Mr. J. Wood, financial superintendent, £475 to £500 (maximum); Mr. J. T. Oakes, traffic superintendent, £450 to £475 (maximum £500); Mr. F. A. Mitcheson, accountant, £375 to £400 (maximum); Mr. G. R. Blackburn, rolling stock superintendent, £350 to £370 (maximum £400); Mr. T. Ridyard, car works manager, £250 to £270 (maximum £300); Mr. R. Beattie, chief claims clerk, £325 to £350 (maximum); Mr. T. G. King, stores superintendent, £250 to £275 (maximum £300); Mr. H. Jackson, chief clerk, traffic department, £240 to £250 (maximum); Mr. J. W. Hewitt, cashier, £225 to £245 (maximum £300); Mr. W. Grey, chief clerk, general office, £220 to £235 (maximum £250); Mr. C. H. Pepper, assistant accountant, £205 to £220 (maximum £250). The following advances were made in the electricity department:—Mr. L. H. Marlor, installation inspector, £220 to £235; Mr. F. R. Radcliffe, chief rental clerk, £215 to £225; Mr. E. J. Constable, assistant resident engineer, city stations, £200 to £220; Mr. L. R. Lee, mains engineer, £450 to £475; Mr. H. A. Ratcliff, head of testing department, Polygon, £300 to £325; and Mr. E. Bolton, substations engineer, £350 to £375.

The Keighley Town Council last week appointed Mr. H. Webber, the borough electrical engineer, to be tramways manager, to date from October 15th last, at a salary of £100 a year. Great praise was expressed concerning Mr. Webber's work in the tramways department since his appointment as temporary manager last October. One member objected to the appointment on the ground that the result of Mr. Webber's occupying the dual position could not have a good result.

General.—The American *Electrical Review and Western Electrician* states that the Franklin Institute, Philadelphia, acting through its Committee on Science and the Arts, has recently awarded the Elliott Cresson gold medal, the highest honour in the gift of the Institute, to the following: C. P. Steinmetz, Schenectady, in recognition of successful application of analytical method to the solution of numerous problems of first practical importance in the field of electrical engineering; Emile Berliner, Washington, in recognition of important contributions to telephony and to the science and art of sound-reproduction; Isham Randolph, Chicago, in recognition of distinguished achievement in the field of civil engineering; John William Strutt, Baron Rayleigh, in recognition of extended researches of signal importance in physical science; Sir William Ramsay, in recognition of numerous discoveries of far-reaching importance in the science of chemistry; Emil Fischer, Berlin, in recognition of numerous contributions of fundamental importance to the science of organic and biological chemistry.

The *Australian Mining Standard* for February 15th stated that Mr. W. Fitzpatrick, chairman of the Victorian Railways Commissioners, was about to leave for Europe and America to study the newest electrical railway systems, giving special attention to points bearing on that part of the electrification of the Melbourne railways that has not yet been authorised by Parliament—the new electrical signalling apparatus for ensuring the proper control of the electric train service. Mr. Fitzpatrick will probably be away from the State for about five months. The Commissioners have also decided to send Mr. E. Blazey, the superintendent of goods train service, and Mr. F. C. Calcutt, chief engineer of signals, on a tour of inspection relative to electrification of railways, the main point of their inquiries being the latest and most effective systems of signalling. "They will leave on March 11th, and will visit England, France and America, Mr. Fitzpatrick leaving on April 8th."

Our American namesake says it is announced that the Edison Electric Illuminating Co., of Boston, has arranged to retain the services of Mr. Arthur Wright, of London, in a general advisory capacity.

Mr. Anthony G. Lyster has been taken into partnership with Sir J. Wolfe Barry, Mr. G. E. Wilson Crutwell and Mr. K. A. Wolfe Barry as Sir John Wolfe Barry & Partners, 2, Queen Anne's Gate, S.W.

At Bradford Parish Church on Thursday, last week, Mr. Joe Dyson, principal of the firm of Messrs. J. Dyson & Co., electrical engineers, Bradford, was married to Miss Winifred Muff, youngest daughter of Mr. John Muff, the chairman of the Bradford Board of Guardians.

At the Star Hotel, Cudworth, Yorks., last week, a presentation of a marble clock and ornaments, appropriately inscribed, was made to Mr. Wm. Walker, who is leaving the post of electrician at the Grimethorpe Colliery, Cudworth, to take up a position at Pendlebury Collieries, near Manchester. A presentation of a silver breakfast cruet was made to Mrs. Walker. A pleasant musical and social evening was spent.

Mr. E. H. Field, of the staff of Messrs. Crompton & Co., Ltd., Arc Works, Chelmsford, has been presented, on his marriage, with a marble clock by the members of the staff at the works.

Messrs. Heap & Digby announce that they have removed from 28, Victoria Street, Westminster, S.W., to 48, Westminster Palace Gardens, Victoria Street, S.W.

CITY NOTES.

British Insulated and Helsby Cables, Ltd.

Presiding over the annual meeting of this company, which was held at Liverpool on March 17th, Dr. E. K. Muspratt stated that the profit for the year amounted to £218,394, compared with £188,258 for the previous year, showing an increase of £30,136. The result was most satisfactory, particularly in view of the fact that during the year the company's operations were considerably hampered by the coal strike. During the previous year £44,416 was expended on increased plant and machinery, and the results had amply justified the course taken. The sale of the Liverpool works to the Automatic Telephone Co. had been completed, and the holding they now had in that company was likely to prove a valuable asset in the future. It was expected now that the Government had taken over the telephone system of the country, that a considerable demand would arise for the extension of telephone work generally, and they could with confidence look forward to getting a fair share of that work. With

regard to the profit and loss account, when they added the balance brought forward from 1911, they had available for all purposes £282,045, which had been dealt with as shown in the report. The balance available for distribution was £104,230. The directors recommended a further dividend of 6s. per share, making, with the interim dividend already paid, a total distribution for the year of 10 per cent., leaving a balance to carry forward of £74,230, which was an increase on last year's "carry forward" of £10,580. The sum of £5,000 had again been placed to the debenture stock redemption fund, and this could be looked upon as an addition to ordinary reserve. On referring to the balance-sheet it would be seen that after crediting the amount received from the sale of plant at the Liverpool works, and debiting the amounts expended during the year at their Prescot and Helsby factories, the amount now stood at £619,489, compared with £641,876 last year. In this connection the directors were following the policy of judiciously extending the company's manufacturing plant in accordance with the demand, and the directors thought that returned the best profit obtainable. In last year's balance-sheet the amount against the item of patents and goodwill stood at £71,500. The directors had decided to further reduce this amount by taking from profit and loss £36,500, leaving the amount standing in the balance-sheet under this heading at £35,000. At one time patents and goodwill stood at £251,672. If business continued good, it was the directors' wish to extinguish this item altogether. The value of stock and work in progress had increased by £65,838. This was partly due to the increased price of raw materials as well as to the increased volume of manufactures in progress. The sum under the head of sundry debtors had been increased by £106,148 for similar reasons. With regard to investments, this account, after writing off £8,500, now stood at £614,077, as against £552,193 last year. The position had, however, improved during the past year, owing to the fact that though they had obtained £120,000 ordinary £1 shares in the Automatic Telephone Co., their investment account had only increased during the past 12 months by £61,884. With regard to the Midland Electric Corporation for Power Distribution, Ltd., in which the company had a very substantial interest, a further marked improvement had taken place, the net revenue account for the past year, after paying debenture interest, having increased from £2,500 to £12,843. The present issue of Midland Electric Corporation debentures would fall due in June next, and it was proposed to re-issue these, together with a further amount, so as to provide a substantial sum for future extensions of that company's operations, necessitated by the growing demands for electric energy in that district. Their company (the British Insulated) originally guaranteed the present issue of the Midland Co.'s debentures as to capital and interest, and it was proposed by the directors, in order to facilitate the present issue and to obtain as low a rate of interest as possible, that the company continue the same guarantee with regard to the new issue. As, however, the Midland Co.'s profits had been continually improving, and were sufficient to cover the interest on the whole of the proposed increase of new debentures, it was not contemplated that this further guarantee would, in effect, cost the company anything. With regard to the Electric Supply Co., of Victoria, the other company in which they were particularly interested, he was pleased to report a further considerable improvement in the position. The British Insulated Co. had credits at various banks, principally abroad, of over £14,000, as against an overdraft on their own bankers at home of over £73,000.

The report and accounts were adopted, and a resolution authorising the payment of the dividend was passed.

Mr. J. Carlton Scott and Mr. J. S. Harmood Banner were re-elected to the board.

Montana Power Co. — Quarterly dividends of 1 per cent. on the common stock and of 1¾ per cent. on the preferred stock have been declared.

Consolidated Cities Light, Power and Traction Co. —A first quarterly dividend of ½ per cent. on the common stock is announced.

Tramways and Light Railways Estates Co., Ltd.— The total revenue for 1912 was £735. A dividend of 2½ per cent. is paid, and £262 carried forward.

Prospectus.—*Mississippi River Power Co.*—The list is to close on March 27th in an offer of $3,000,000 first mortgage 5 per cent. 40-year gold bonds at £91 per bond of $500.

Shawinigan Water and Power Co.—Dividend 1½ per cent. for the quarter ending March 31st on the Common stock.

Great Northern Telegraph Co., Ltd., of Denmark.— At the general meeting, which will be held at Copenhagen on April 26th, the board will propose to pay a total dividend and bonus of 20 per cent. for the year 1912, including the 5 per cent. already paid, and to transfer to the reserve and pension funds the usual amounts besides an extraordinary endowment once for all to the last-mentioned fund.

Jarrow and District Electric Traction Co., Ltd.— The report for 1912, as abstracted in a financial daily, states that the accounts show an available sum, after providing for debenture interest and placing £700 to renewals account, of £2,867. A dividend of 2 per cent. is to be paid, £1,025 put to depreciation and reserve account, and £843 carried forward.

Mexico Tramways Co.—The directors have declared a dividend of 1¼ per cent.

Salisbury Electric Light and Supply Co., Ltd.

The directors' report for 1912, which was adopted at the meeting held on March 11th, says that the generating plant has been sufficient to meet the output, and the whole of the plant is in thorough working order and capable of dealing with a considerably increased demand. The profit on the year's working, including £449 brought forward, amounts to £6,795, and after paying £1,290 interest on debentures and an interim dividend at the rate of 4 per cent. for the half-year, amounting to £700, there remains a balance of £4,804. The directors recommend that a further dividend at the rate of 8 per cent. for the half-year be paid, making, with the interim dividend, 6 per cent. for the year, and that £2,400 be carried to reserve, leaving £1,004 to be carried forward.

Mr. W. M. Hammick presided at the annual meeting, and in moving the adoption of the report, he said that not only were they paying the same dividend as last year, but they were carrying forward £1,004, instead of £449. The auditors drew attention to the insufficiency of the reserve fund, and they were catching up yearly to the point that the auditors thought should be attained in this respect. The coal contract was only 1s. 7d. a ton more than in the previous year, but the consumption had been reduced, the bill being only £65 more. The water supply had been better, but the floods had not assisted them at all, as when the river was in flood they did not get the value of their turbine, as they did when the water was moderately high. The sale of current was very good. The working expenses of 1911 and 1912 were practically the same.

Mr. Gripper seconded, and the report was adopted.

Thanks were voted to the staff, special mention being made to the services of Mr. A. R. Randall, the engineer and manager, Mr. Godwin, and Mr. Bamkin.

Newmarket Electric Light Co., Ltd.—The directors' report for 1912 states that the equivalent of 772 33-watt lamps have been connected to the mains, making the total 27,811 lamps. Applications for a further 430 lamps have been received this year. The whole of the works have been maintained in perfect working order. The profit, added to £10 brought forward, amounts to £2,569, which, after providing for debenture and other interest, £745 leaves a balance of £1,824. The directors recommend a dividend of £4 per cent.; that £700 be carried to reserve for renewal of plant, and that the balance be carried forward. The directors record the death last year of the chairman, Mr. J. Garrod. Mr. F. E. Gripper was elected chairman in his place for the remainder of the year, and Mr. F. W. Cobb, of Cheveley, was elected a director in place of the late Mr. Garrod. The meeting was held on March 17th.

Clyde Valley Electrical Power Co.—The half-yearly meeting was held in Glasgow, Dr. J. MacKenzie presiding. The chairman moved the adoption of the accounts, which (according to the *Scotsman*), showed a net profit of £24,718 for the six months ending December, 1912, together with £3,647 brought forward, making a disposable balance of £28,365. He stated that the board had decided to transfer the sum of £12,500 to contingency fund for depreciation, &c., bringing this fund up to the total of £56,600, and to carry forward £15,865. The company's business continued to show steady progress, and the number of new contracts recently closed and in course of negotiation justified the expectation that this progress will be maintained. Contracts for supply showed an increase of 5,000 H.P. during the half-year. The report and accounts were adopted. The meeting authorised the issue of the remaining £300,000 of capital in the form of 30,000 6 per cent. cumulative preference shares of £10 each.

Stock Exchange Notices.—The Committee have ordered the undermentioned to be quoted in the Official List:—

British Columbia Telephone Co., Ltd.—10,000 6 per cent. cumulative preference shares of $100 each, fully paid (Nos. 1 to 10,000).

Compania Hidro-Electrica de Tucuman.—£300,000 5 per cent. first mortgage debentures of £100 each (Nos. 1 to 3,000).

Wemyss and District Tramways Co., Ltd.—The board have under consideration doubling certain portions of the track with the view of expediting the service to Kirkcaldy. In their annual report the directors note that the profits for the year, together with the balance brought forward, after providing interest on debenture stock, and writing £1,000 off account for betterment of the undertaking, amounts to £3,643. The dividends are 6 per cent. on the preference and two dividends of 3 per cent. on the ordinary shares.

Gandy Belt Manufacturing Co., Ltd.—The profit for 1912 was £18,273, plus £1,542 brought forward. The dividend for the year is 10 per cent., and £1,584 is carried forward.

Fairbairn, Lawson, Combe, Barbour, Ltd.—The profit for 1912 was £33,269, as compared with £58,075 for 1911. The dividend for the year is 5 per cent., as compared with 7½ per cent. for 1911; £22,745 is carried forward, as compared with £47,136.

Isle of Wight Electric Light and Power Co., Ltd. —The net profits for 1912, including £2,115 brought forward, was £16,286. The *Financier* states that a dividend of 2 per cent. on the ordinary shares is proposed, adding £3,500 to renewals and £1,000 to the reserve, carrying forward £2,800.

Mexican Light and Power Co., Ltd.—Dividend 1 per cent. on the ordinary shares, and 3½ per cent. for the six months ended April 30th on the preference shares.

Guildford Electricity Supply Co., Ltd.

THE directors' report for 1912 again records very satisfactory progress, the gross receipts being £10,069, as compared with £8,679 for 1911, showing an increased revenue of £1,389. There is a balance on the revenue account of £3,705 (after crediting depreciation fund account with £1,250), as compared with a balance of £3,303 (after crediting depreciation fund account with £1,000) on the revenue account for 1911. After making due provision for debenture interest, dividend on preference shares, &c., and the placing of £500 to the credit of reserve fund account, the net revenue account shows a balance of £1,075 for distribution. Out of this sum the directors recommend the payment of a dividend at the rate of 5 per cent., less tax, for the past year, on the ordinary share capital which will absorb £731, thereby leaving a balance of £344 to be carried forward. The following table shows the progress of the business :—

Year.	No. of connections.	Total revenue.	Total costs.	Gross profit.
1909	744	£7,490	£3,198	£4,292
1910	807	7,885	3,441	4,444
1911	874	8,679	4,376	4,303
1912	969	10,069	5,114	4,955

The above progress has made it necessary to enlarge the company's works, and for this purpose the freehold land and buildings situate between the company's works and the premises of Messrs. Dennis Bros., Ltd., have been purchased. A new engine room is now in course of erection, which will accommodate a further 1,100 H.P. of generating plant, of which 550 H.P. is now being installed.

	1912.	1911.
Units sold—Lighting	331,930	295,930
Power and heating	437,896	256,515
Total	769,826	552,445
H.P. of motors connected	753	553
Total number of connections	969	874

County of Durham Electrical Power Distribution Co., Ltd.

THE annual general meeting was held in Newcastle-on-Tyne on 19th inst., Dr. J. T. Merz presiding.

The CHAIRMAN, in moving the adoption of the report (see ELEC. REV., p. 445), said the progress of the company had been very slow in the past year, very largely due to the interruptions of trade that took place. The increase of connections with the company's system had been 11,000 H.P., in respect to which the current year ought to reap the benefit. It was satisfactory to know that the increase had been more than in former years. The profit was only £7,000 more than in the preceding year, but they had written £843 off their manufacturing plant, and £850 off their connections for house services, and their lighting load had gone up considerably. The capital expenditure had been only trifling, £2,277 ; but this was due to the fact that the Durham Co. had sold to the Newcastle-on-Tyne Supply Co. £45,000 worth of mains. The company was not in a position to raise money easily, and therefore it depended largely upon the financing of its sister Supply Co., the company which took it over and promoted it seven or eight years ago ; so the £45,000 raised in the way mentioned had been spent in the extension of the business in other directions. A Birmingham shareholder had written a letter expressing dissatisfaction with the progress of the company. The shareholder wrote, in effect, that it seemed clear either that the cost of the original installation was needlessly extravagant, or that the rates at which they supplied current were entirely unprofitable, or that their organisation for increasing the sale of current was defective ; also that it was difficult to avoid the impression that all three were the cause, and he suggested that it was time either to reorganise the board of management, or the capital, or both. Well, he was glad to answer those questions. In regard to the prices charged by the company, they were slightly more than the prices charged by the Newcastle Supply Co. and the Newcastle Co. was supposed to be the most successful company of its kind in the kingdom, and he might perhaps, add that as a power company it was the only company that had met with some considerable success. Therefore it could not be a matter of prices. As to the management, the company was entirely in the hands of the staff and directors of the Newcastle Co., with one exception, and that was a gentleman who was capable of criticising and watching the affairs of the company, so there could be no complaint as to the management of the company. As to the company being overburdened with capital, he might give a little explanation of the real position. Their company was originally started 12 years ago, and it was carried on for some years before the Newcastle Supply took it over and bought the shares, or, rather, retained some and offered the others to the public, together with a larger amount of capital that was issued. At that time there was a great boom in electricity concerns, and many promoters and irresponsible persons rushed into the field and promised to get electric stations and electric supply organisations in order to supply customers very cheaply. The result was that the company started in that district without any statutory powers whatever, merely through private connections, and supplied current at unnecessarily low prices. These prices were certainly 25 per cent. lower than they should have been, with the result that the company was prevented from entering into contracts for any large amount of electricity at any high figures. Had those prices been only 25 per cent. more for the first five or six years their company would have made a considerable sum of money. In addition to this the company had been saddled with a considerable amount of unnecessary capital. That capital had been spent on plant that had become obsolete, and had to be renewed. Again, the company included in its area several communities such as Sunderland and South Shields, which, out of pure sentiment, had chosen to supply their own electricity at a much greater cost than they could have got it from the company. That, however, could not now be helped. What they were now aiming at was to try and increase the load, and that could only be done by progressing on the lines which they had followed so far. He thought they would see that all this criticism as to overloading of capital, or low prices, or failure of the management, could be discredited. The management was the same as that of the Newcastle company, a successful company, the capital could not be altered, and the prices could not be raised. The only way of getting out of the difficulty was to increase their load, and this they were trying to do.

SIR LINDSAY WOOD seconded the report, which was carried, and the retiring directors were re-elected.

Newcastle-on-Tyne Electric Supply Co., Ltd.

THE annual meeting was held in Newcastle on 19th inst., Dr. J. T. Merz presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 440), said that the connections to the company's system at the end of the year amounted to 174,327 H.P., showing the large increase of 22,700 H.P. over the previous year. The capital expended in the 12 months had been £167,081. In former years he had stated that the amount of capital spent in proportion to horse-power connected would go down, but that statement was not quite correct so far as last year was concerned. If they took the capital expended, £167,000, they would find that it represented about 7 guineas per additional H.P. connected. In former years he had said the latter sum might come down to 5 guineas or £5. This required some explanation. The capital they were now spending, and had spent for some years, and notably last year, was not spent entirely in reaching consumers. The company had now a new department in its business, of which he had spoken on former occasions, but it had been very largely developed in the course of last year, and would be still more largely developed in the future. This was receiving supplies of electrical current from waste-heat stations situated near the coal mines themselves. This was a development of what had been called the waste-heat industry. Electrical current was now generated by the company in connection with coalowners at the mines, and especially where coke ovens existed. This waste heat and gas could not be used except on the spot, and, therefore, instead of bringing their fuel in that shape to their works, they went with their works to the fuel. They had now two classes of industrial concerns connected with them. First, there was the larger class of consumers who used electrical current for their own purposes, and, in the second place, they had those who produced waste heat and gas, which the company received on the spot and converted into electricity, usually in partnership with the coalowners. Therefore, the capital they now spent on mains was not only the capital spent on reaching consumers, but also capital spent upon mains by which they could conduct electricity made in various outlying places, where, to a large extent, it was of no use, into the centre of their distributing system. These mains belonged to the company, and were a valuable asset. They were a link for bringing electricity from outlying places, and for supplying consumers on the way. For these mains they had received a considerable sum—£22,500—which was really a repayment of profit. If they had not got that sum, they would have had to recoup themselves probably in the terms which they would have charged. This £22,500 was not brought into the profit and loss account, and did not ostensibly appear in the balance-sheet. Dr. Merz referred the shareholders to statement No. 8 in the accounts—investments—and said those investments in former years stood at a higher figure than at present —£73,000. If they compared this amount with that of last year, they would find that the figure was now £22,500 less, this sum having been taken off and utilised as an amount to discount the value of that asset, which had been written down by £22,500. If they took this figure from the amount spent in reaching new consumers, they would find that the capital spent per horse-power was £5 7s. 3d., which was coming near the figure he had mentioned in former years. The business of the company, continued Dr. Merz, had been materially interfered with and hampered by the coal strike. It was impossible to say how much the coal strike cost the company, partly in reduced output, in the cancellation of coal contracts, having to pay more for their coal, also in purchasing coal in the market at high prices in order to prevent any chance of stoppage, and lastly, in the deterioration of the large stock of coal which they held. The amount written off the coal stock was £1,419. That was in the shape of deterioration, but was not mentioned as deterioration in the report. The net profit of the company had increased by £2,600. They had now 22 motor-cars which stood on the books at £4,300, or less than £200 per car. They had spent £723 in replenishing these cars, and that sum had come out of revenue. The sum of £2,845 had been spent in making connections to dwelling houses, this being, of course, new business. Dr. Merz mentioned that, in regard to waste heat, the company benefited to the extent of an equivalent of about 70,000 tons of coal, which, he said, was a very large item. They might want to know how they got the £167,000 which they had spent out of capital. First of all, they took £28,400 out of the cash they had in hand, then they recalled loans which were standing out, and repaid those

owing to them, and the difference gave them £36,754. They afterwards borrowed from the bank £100,580, making up the total to £165,754. Of that sum, £3,600 had been spent on stations and the mains of the company, and £45,000 was paid over to the Durham company in purchase of mains in their district. These mains were laid down by the Durham company, and paid for by it, but the Durham company allowed the Newcastle company to use the mains, and they formed a large portion of the mains by which the latter company got the waste heat current. They could be used for supplying electricity and for bringing electricity from other places. These mains formed a link in the company's circle, and it was better that the Newcastle company should own the whole circle. The Durham company paid them rent, which gave the Newcastle company a return on the capital. The Durham company was the largest customer of the Newcastle company, which was anxious that the Durham company should increase its business as much as possible.

Sir Lindsay Wood, Bart., seconded the adoption of the report, which was carried.

Dividends at the rate of 5 per cent. on the preference shares and at the rate of 5 per cent. on the ordinary shares, were declared.

The Chairman then drew attention to the question of directors' fees. He said that the subject had not been dealt with for 11 years, when the dimensions of the company were less than one-fifth what they now were. Three years ago he had mentioned that the matter would be brought up at the next meeting, but when that meeting came the question was postponed for various reasons.

Mr. N. H. Martin moved that the remuneration of the directors for the past year be £1,500, and that that sum be their annual remuneration until it is altered by a general meeting.

South London Electric Supply Corporation, Ltd.

The annual meeting was held on March 18th at the Cannon Street Hotel, E.C., Mr. J. Atherton presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, page 441), said he thought they would agree that the results of the year's working had been very satisfactory, the lamps added to the circuits during the year being the equivalent of 22,585 35-watt lamps; this was the largest increase they had had since the year 1908. The total lamp connections at the end of the year amounted to 273,306 (since increased to over 286,000), and he was glad to say that nearly 40 per cent. of this increase was due to new lighting connections. As he pointed out last year, they then hoped that the influence of the metal-filament lamp in depressing their lighting revenue had been overcome, and he was pleased to say that their expectation had been realised. The power side of the company's business had also made very satisfactory progress during the year, and nearly 650 H.P. of additional motors had been connected to the mains, bringing the total up to 4,600 H.P., and the units sold for power were again practically equal to the units sold for lighting. The result of these additional connections was an increase in the units sold of 520,631, and the total units sold for the year amounted to 5,000,118, as compared with 4,479,487 in the previous year, or an increase of 11·6 per cent, and the revenue obtained had been increased by nearly £4,000. In regard to the costs of production, these had increased by £1,587, and the gross profit had risen by £2,321, as against a rise in the previous year of £1,774. The largest increase in expenditure had been for coal, due to the abnormal price which this was now commanding, and which constituted a heavy tax upon all industry. Adding together all the items of expenditure under the revenue account, the sum total was £20,859, which worked out at the very satisfactory figure of 1d. per unit sold, as compared with 1·03d. in the previous year, this result being again one of the best obtained by any of the companies supplying electricity in the metropolis. Last year he told them that after very careful consideration they had decided to install a further 2,000 KW. turbine, and to change the system of generation from single-phase to two-phase, and they then hoped that this work would have been completed by the early part of last September. The coal strike and other labour troubles, however, completely upset their calculations, and they had to give their contractors an extension of time, and the plant was not completed until the latter part of November, so that although practically the whole of the capital expenditure for the new turbo-alternator, cables, switchgear and other apparatus for the change over to the two-phase system was included in the capital account, it had not been productive of any revenue during the year. The capital expenditure during the year amounted to £17,312, principally incurred for the new turbine and the change over to the two-phase system. This change was made in the early part of the present year, and he was more than pleased to say that the resulting business was satisfactory. The new machinery was running well, and the change had been effected without the supply to any consumer being interrupted. Their sales department continued to grow apace, and as the accommodation in the offices at the works had become insufficient, they had decided to open central showrooms in one of the main thoroughfares in their area of supply. The total amount available for distribution was £28,472, and out of this sum they had provided £6,000 for depreciation on plant and machinery. The item of £2,574 for renewals represented principally the value of the first generating set installed in the works, and this had been disposed of to make room for the new 2,000-KW. turbo-alternator. After providing for debenture interest and other interest accrued, &c., there remained to be carried to the general balance-sheet the sum of £15,183, out of which the board recommended a dividend on the ordinary shares at the rate of 5½ per cent. per annum, an increase of one-half per cent. over the preceding year, and in view of the enhanced price of coal and other difficulties with which they had to contend during the year, they thought the shareholders would agree that this was a very satisfactory result.

Mr. R. A. Bush, a shareholder, seconded the motion.

Mr. Boot congratulated the shareholders upon the satisfactory progress which the company had made since its inception. Now that the board had adopted the two-phase system, they could, he said, enter more widely into the field of competing for power on the very best terms, and he believed that the company was only in its infancy in that respect. There were a great many large factories in the area which hitherto they had not been able to tackle, and they might safely leave the development in the hands of the directors and the capable manager, Mr. Sprunt.

The Chairman, in reply to questions, said the debenture issue was made at 99 per cent. As to an interim dividend, the board thought such a policy inadvisable at the present time.

The report was adopted.

Evered & Co., Ltd.

The directors report that the trading for 1912 resulted, after the provision of £1,410 for debenture interest and £176 for income-tax, in a net profit of £13,256, plus £2,090 brought forward, making £15,346 to be dealt with. They recommend a dividend of 5 per cent., free of income-tax (£8,537), put to writing off plant, £2,500, and propose to carry forward £4,309.

The increase in the turnover reported during the previous year has been continued, and has reached a total which has not been approached for some years past, enabling the whole of the works to be kept fully going during the past financial year. Stocks of raw material at the works have been taken on the same fixed basis as in former years, and, therefore, very considerably below cost or market value. All part-manufactured and finished stock has been brought into account at the figures obtaining in the beginning of the year, since when large advances in cost of manufacture have occurred, and in the opinion of the managing directors the actual value of the stock at to-day's market prices is distinctly in excess of the amount at which it appears in the balance-sheet. But, in view of the uncertain position of the metal market, such action appears to the board to be wise. Machinery and plant, in addition to the writing off above proposed, have been maintained and renewed, and are in fully efficient condition. The depreciation of buildings has been provided for by the lease redemption policies mentioned in the last report.

The meeting will be held at Drury Lane offices on Monday.

Kettlewell Electricity Supply Co., Ltd.—A meeting of the shareholders of this company, which has recently been formed in connection with one of the West Yorkshire village schemes for generating energy by means of local water power, was held last week, when it was reported that the scheme was making satisfactory progress, and the directors hoped to be able to declare a dividend in due course. Messrs. O. Robinson (chairman), J. H. Coates (vice-chairman), L. Gaunt, Walsh, J. Raw, W. L. Carradice, and T. Inman were elected directors, and Mr. W. P. Inman, secretary.

Liverpool District Lighting Co., Ltd.—Mr. Charles McLaren presided over the annual meeting of this company, and in proposing the adoption of the accounts, he stated that during the year the company had increased their sales of electricity by over 50,000 units, and had added 3,515 lamps to the supply system. The extra profit, however, had been nearly all taken up in the increased cost of fuel and labour, and the extra expense incurred during the coal strike. The company were now making a business of hiring electric heating and cooking apparatus, and it was expected that the increased revenue from this source would make the figures for 1913 even better than for the preceding year. The increase in consumers necessitated increased capital expenditure for laying mains, and more plant would be required during the coming winter to meet the increased demand. Mr. Holbrook Gaskell, who seconded, pointed out that for the first 2½ months of 1913 the company was progressing more rapidly than in 1912. The report was adopted.

Hadfield's Steel Foundry Co., Ltd.—At the annual meeting on 17th inst., Sir R. Hadfield said that he hoped we should have nothing like conscription in this country to interfere with industry. It would be a great mistake to have men withdrawn from productive employment. The *Times* reports that in reply to a shareholder, Sir Robert said that while Hadfields were not likely to try anything venturesome, "they were going to launch out a bit."

Winnipeg Electric Railway Co.—The report for 1912 states (says the *Times*) that the gross earnings were $3,765,384, as compared with $3 829,749. The net earnings were $1,761.236, as compared with $1,928,782. After providing for the percentage on earnings accrued the city and interest on bonds, the directors declared four quarterly dividends, amounting to $720,000, leaving a surplus of $474,463, which has been transferred to the credit of profit and loss account, making a total credit to that account at December 31st of $2,091,236.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended February 28th, 1913, amounted to 790,198, compared with 658,948 units in the corresponding four weeks of 1912.

British L. M. Ericsson Manufacturing Co., Ltd.

THE directors' report for the year ended December 31st, 1912, states that the net profit amounts to £18,563. The directors recommend that after payment of 6 per cent. to the preference shareholders, the balance of £13,941 be appropriated as follows:—Dividend of 8 per cent. (free of income-tax) to the ordinary shareholders, requiring £8,001, carrying forward £5,940.

The annual meeting was held on March 19th, at the Memorial Hall, Farringdon Street, E.C., MR. W. M. CROWE, chairman and managing director, presided, and in proposing the adoption of the above report, he said that although that was the tenth annual meeting of the company, it was the first time that the directors had had the pleasure of meeting with the shareholders. Formerly the company was a private one, held practically by two shareholders—the National Telephone Co., and Messrs. Ericsson, of Stockholm. Therefore, the annual meeting was more of a form than a reality. He thought they would agree with the directors that the result of the year's working had been exceedingly good, and particularly so was that the case when they remembered that in common with other manufacturing concerns they had had a good deal to contend with. Early last year they had a series of strikes, including the coal strike, and the price of raw material went up considerably, and wages also rose. Coal was a commodity that they used a great deal of, and they had to pay some 65 per cent. more for it last year than in 1911. Then they had been burdened with extra taxation. The National Insurance Act cost them many hundreds a year. Then, again, their chief customer in this country—the Postmaster-General—had not put through so many orders in 1912 as he did in 1911. It would be remembered that in 1911 he had in prospect the taking over of the business of the National Telephone Co., and he, therefore, put in hand enormous supplies of material, and that company and other telephone manufacturers in the country put as much work through during that year as they could, and, consequently, they made big profits. He was glad to say that 1913 had started well, and should matters go on as they were at present, they hoped to meet the shareholders this time next year with as good, if not better, results than they showed that day. One thing was certain, and that was that there was any amount of work to be done in this country in telephones. When they compared this country with other go-a-head countries, they found that we were very far behind in telephones. If they took representative towns in the United States of America and some of the countries of Europe and compared them with towns in this country, it was found that we had a long way to go before we were equal with those other countries. London, for instance, had a telephone for every 35 inhabitants. New York had one for every 12; Chicago one for every 9; Washington one for every 6. If they went to Stockholm they found there that they had a telephone for every 5 inhabitants, and in Copenhagen there was one for every 12. Turning to our own country, as he had said, London had one for every 35 inhabitants; Birmingham had one for every 72; Liverpool one for every 40; Manchester one for every 47, and the other towns were in a like state. It would, therefore, be seen that before England was on equal terms with the countries he had mentioned, telephone manufacturers would have a great deal of work put through their hands. He was glad to say that the Postmaster-General and the officials under him realised this state of affairs, and they were tackling the matter in a businesslike way. They hope, therefore, that before many years were over they would be equal with the most advanced countries in respect to telephones. One thing he regretted, and particularly for the sake of their own company, and that was that the Postmaster-General had decided to continue the policy of the National Telephone Co. in withdrawing the hand micro-telephone from use in this country. That was a small instrument with the receiver and the transmitter combined. While we were removing this instrument, other countries were installing it. France, for instance, within the past six months had made the hand micro-telephone the standard for the country, and their friends in Stockholm had given large orders for the instrument. Turning to the accounts it would be seen that no amount was put aside for reserves, but during the year the amount written off for depreciation was within a few pounds of £10,000. The directors considered that that amount was ample and even generous under that head, and he believed that the shareholders would agree with them. It was especially ample when it was known that during the partnership of Messrs. Ericsson and the National Telephone Co. depreciation was written off at a very high rate indeed. An agreement existed between those two concerns which provided that after depreciation was written off every penny was profit which would be divided, therefore there was no reason for the heading "reserves"—the depreciation was at such a high rate that it served the purpose of depreciation and reserve. It would be remembered that before the issue of the prospectus last year, a valuation was made of the assets at the Beeston factory, and they were put down at £116,786, and that was after sufficient allowance had been made for depreciation. Those assets stood in the books at the company at £86,674, so that there was a reserve of £30,000, which did not appear in the account. It was the intention of the directors immediately they found it convenient to do so, to build up a reserve, in addition to continuing the present rates of depreciation. It must also be remembered that the fixed assets, the machinery, power plant, &c., had been kept up to the highest standard of efficiency out of revenue. Again, although the company had a valuable goodwill, and had valuable patents, having a right to all the patents taken out by Messrs. Ericsson, of Stockholm, no amount stood in the books for them. It would, therefore, be seen that the company had not a penny of water in its capital. Turning to the balance-sheet, it would be seen that the cash in hand amounted to £68,000, which was £18,000 more than would be required to pay off the whole debenture issue, and to that had to be added the value of the stocks, which gave them a total of £111,300, or more than enough to cover the whole preference issue, and that was without touching the fixed assets, amounting to £96,600. The stocks in hand were practically all made under firm orders, and were, therefore, as good as liquid cash. The other liquid asset, sundry debtors £26,000, was £7,700 more than was necessary to pay off sundry creditors, and the amount of bad debts during last year was only £20. The fixed assets had increased considerably since 1911, the reason being that during last year an addition was made to the factory in the shape of warehouses, stores, and a testing department. The amount carried forward was practically sufficient to pay the preference dividend for 1913, therefore, taking everything into account, he thought it would be agreed that the security of the shareholders and the debenture-holders, and the position of the company generally, were about as good as could be wished for.

MR. HAROLD SANDS seconded the motion, and the report was adopted.

Hove Electric Lighting Co., Ltd.

THE annual meeting was held on March 19th at Salisbury House, E.C., Mr. Carleton F. Tufnell presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, page 442), said that the capital expenditure during the year had amounted to £1,300, the principal item being £889 for extension of mains. The gross revenue had increased from £24,840 to £25,220, and the expenditure from £10,383 to £10,590, the profit carried to net revenue being £14,630, as compared with £14,457 in 1911. That was a small increase, but it was satisfactory in that last year they had to announce a reduction of profits to the extent of nearly £1,000 in comparison with the then previous year. The units sold in 1912 amounted to 1,169,003, as compared with 1,139,328 in 1911—a very satisfactory increase. Taking into the account the balance brought forward from 1911, and deducting the dividends paid on the preference and ordinary shares and also making provision for debenture interest accrued, there remained a surplus of £9,283, and as the outcome of the year's working, they again recommended the payment of a dividend at the rate of 10 per cent. per annum, making 9 per cent. for the year. They would, perhaps, expect him to say something with reference to the notice received from the Hove Corporation of their intention to exercise the option of purchasing the company's undertaking. The notice stated that the purchase was to be by way of repayment of the legitimate capital expenditure of the company, which was one of the two alternatives open for selection by the Corporation. Immediately on receiving the notice the directors thought it was only right to inform the shareholders, and this they did by a circular letter on December 3rd last. The Hove Corporation had lodged a Bill in Parliament for the purpose of enabling them to raise the necessary money for the purchase, and it was a condition of the Bill that until the transfer was actually effected by the payment of the purchase money the company would carry on the undertaking for the benefit of the shareholders. They must all regret the contemplated purchase, as the business had been a satisfactory one from the very start. He would again like to compliment the staff, both in London and Hove, upon the efficiency of their work, and to assure them how thoroughly the directors appreciated their efforts.

COL. H. WOOD seconded the motion.

MR. SCRASE asked whether the board had formed any view as to what the ordinary shareholders were likely to receive as a result of the purchase of the company?

The CHAIRMAN said that according to the terms of the notice the Hove Corporation would pay them the actual capital expenditure, which, up to the present time, was £176,279. Of course they could not tell what further capital expenditure might be necessary during the present year, nor could they tell what the accrued profits might be which would come back to the shareholders.

MR. F. R. REEVES, the managing director, remarked that in addition to the capital expenditure there was the investment reserve fund, which also belonged to the ordinary shareholders, and if they put those two amounts together and deducted the debentures, the debenture stock, and preference shares, which did not share in the surplus assets, they would be able to see pretty clearly what the result was likely to be. A great deal depended upon the view the Hove Corporation might take of the capital expenditure account. If they accepted the audited figures then they would know where they were, but they might dispute some of the items, which of course would bring an uncertain element into the figures.

The CHAIRMAN said he might say that they did not anticipate that there would be any dispute over the matter at all.

The report was adopted.

Empresas Electricas Asociadas.—The directors have declared a dividend of 1¼ per cent. for the last quarter of 1912.

Electrical Distribution of Yorkshire, Ltd.—An extraordinary meeting was held at Leeds on 18th inst. Mr. R. W. Wickham presided. The resolution already passed increasing the capital, was approved.

Metropolitan Electric Supply Co., Ltd.

MR. W. HARRISON CRIPPS presided at this company's annual meeting on March 18th, at Winchester House, E.C.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 445), he said that the capital expenditure was this year £2,013,999, an increase of £114,000. Of this, £51,000 was what he might describe as a direct increase, and £62,800 was an indirect increase. The gross revenue for the year was £202,000, an increase of £19,500. The working expenses were £99,086, an increase of £11,000. After deducting the working expenses there was left to the credit of revenue account, before depreciation, £103,096. They had thought right to put £20,000 to depreciation, and that left £83,096. As regards the increase in the capital account for the year, this figure was the large amount of £114,104, but the amount of cash actually spent was only £51,298. That was expended, to a large extent, for the extension and consolidation of their western area. The difference of the two amounts arose from the amount then standing in the books, which represented the purchase of the Acton undertaking. What they did was to take over that undertaking for a period of 42 years, including all buildings, mains, plant, &c.—in fact, the whole thing, lock, stock and barrel. In exchange for the undertaking, they took over the obligation of the debt and sinking fund for the amount spent by the District Council, less that which they had already repaid, which practically represented the depreciation on the property during the years they held it. Therefore they became liable to pay interest and sinking fund on the unredeemed part of their loan, this loan amounting to £62,863. That item, being a capital charge, had to be shown in the capital account in a separate column. Turning to the revenue account, they would see that they had earned, roughly, an extra £19,000 (the largest increase in one year since parting with Marylebone), at only a working cost of £11,000, leaving £8,000 as a net increase. He trusted they would consider this satisfactory, especially when they remembered that in 1911 the increase of receipts was practically swallowed up by corresponding increase in cost. They could rest assured that the board, ably assisted by their officers, went very carefully into every item of expenditure. There were some items, however, such as coal and rates, over which they had no control, and these two items had both shown a serious increase in their expenses last year. They regarded the future of the company very hopefully, for although, during the current year, there must be a considerable increase in the cost of coal, they also thought that there would be a substantial increase in the revenue. He would again call their attention to the satisfactory condition of the reserve and depreciation fund, to which they had added £20,000, compared with an addition of £15,000 two years ago, and £17,000 last year. It now stood at the substantial total of nearly £300,000. This had been built up for the most part out of revenue, and had been gradually accumulating since the early days of the business. They must remember in considering this fund that all their plant was kept up in the highest state of working efficiency out of revenue, and further, that in their own case they had less than an average depreciation to provide for, because a large amount of the old and depreciated plant was entirely renewed out of the funds obtained from the compensation money paid by the London County Council in taking over their old Sardinia Street works, and nothing was at that time withdrawn from the depreciation fund. In considering the amount of dividend, they thought that, after providing a considerable extra sum for reserve, the shareholders were fairly entitled to some small immediate benefit for the successful working of the year. They still looked cheerfully forward to the future prospects of the company. The business had been steadily expanding, and during the past year the increase in connections was equivalent to 71,267 8-C.P. (30-watt) lamps, and they now had the largest amount of connected lamps in the history of the company, the total exceeding 1 million. The progress had not only been marked in a large further demand for power, but also for light. They would remember that the effect of the introduction of the metal-filament lamp five years ago showed itself in a marked falling off in the sale of light units. This reached its climax in 1910. In 1911 there were symptoms of recovery, and for the first time there was a tendency again to rise slightly. They considered that a most satisfactory feature in this year's report was that this rise had not only been confirmed, but considerably increased, amounting during the year to nearly half-a-million of units, or over 5 per cent. Another source to which they looked for an increased revenue was the gradually extending use of current for cooking. Its use for this purpose had been slow at first — partly owing to the inefficiency of the early cooking ranges, but chiefly to its advantages not being generally known. The London County Council during the past year had had a committee sitting with reference to the future electrical supply of London, and had courteously sought an interview with the collective representatives of some of the companies. They did not know what might be the outcome of it, but he felt sure that any co-operation which would be of mutual benefit both to suppliers and consumers, would be carefully considered. He had often been struck with the fact that many Londoners thought there must be something wrong with the present system of supply, and that they paid too much for their current. With improvements in production there was a tendency for many articles to cheapen, and this would probably apply to current as in other matters. In the meanwhile it was only fair to the electrical undertakings, whether companies or Councils, to say that the public were obtaining their supply of current at a cheaper rate than in almost any capital in the world, a fact which they would discover by a few months' residence in Paris, Berlin, or in any of the big American cities.

SIR JOHN PENDER seconded the resolution.

Mr. FISHER asked if in the conversation with the County Council any suggestion was made that the Acton undertaking should be excluded from any proposed taking over by the County Council.

Mr. HARROP thought the working expenses had increased out of proportion to the income, and whilst he admitted that they were making progress, he did not consider they were making progress fast enough. They had about as many lights now as when they had the Marylebone undertaking, but whereas they paid 10 per cent. in those days, now they were only paying a miserable 4 per cent.

Mr. GURNEY asked if the capital value of the shares was increasing.

Mr. MOORE remarked that they had heard from the chairman that their men had worked well and did not grumble. Having had to do with workmen all his life, which was between 80 and 90 years, he felt they must be paying the men well or they would grumble.

The CHAIRMAN, in reply, said he was not present at the meeting with the County Council, but he understood that no details were discussed. As to Mr. Harrop, they could not talk of what one or another company was doing, unless they studied the history of the company. If they averaged what the shareholders had received over the life of the company, it would amount to considerably more than 4½ per cent. The company was getting as much of the business in Kingsway as others. The price of the company's shares was not in any way under the control of the board.

On the motion of MR. F. LEVERTON HARRIS, seconded by the HON. G. BIRKBECK LUBBOCK, the retiring directors were re-elected.

MR. J. F. E. MULLETT proposed a vote of thanks to the chairman, board and the staff. He was glad to hear that they had an admirable staff of canvassers, which was all-important in these days of keen competition.

MR. W. H. SKEEL seconded the motion, which was carried unanimously.

British Aluminium Co., Ltd.

THE report of the directors, as abstracted in the *Financier*, states that the trading profit for 1912, together with interest and dividend on investments and deposits, and the revenue derived from Kinlochleven and Foyers estates, and transfer fees, is £194,823, plus £4,001 brought forward. Provision for income-tax, legal expenses, bad and doubtful debts, depreciation of investments and furniture, and proportion of profits payable to directors, has absorbed £17,420; prior lien debenture interest, £40,000; debenture stock service fund, £43,223; reserve for depreciation, £40,000; reserve account, £30,000, leaving £28,180. The directors recommend a dividend of 6 per cent. per annum, less income-tax, for the year on the preference share capital, requiring £17,974, leaving to be carried forward £10,206. The reserve account, including the sum of £30,000 added out of the profits of the year, amounts to £80,000. The investment of the balance of this fund will be made during the current year. The depreciation reserve account, including £40,000 set aside out of this year's profits, now stands at £100,000. The aluminium works at Vigelands, near Christiansand, Norway, previously controlled by the Anglo-Norwegian Aluminium Co., Ltd., have been purchased by this company. Part of the price has been paid, and the balance will be paid during the present year. These works, which will add considerably to the company's productive capacity, are now in full operation. The company has also acquired an interest in a works for the manufacture of alumina, to augment the supply from the works at Larne. The output and sales for the year were greater than in any previous year. The prices obtained were low, owing to the keen competition of the foreign producers, but prices for the present year show a material improvement. The demand for the metal continues to increase, and the sales made for the present year are encouraging.

South Wales Electrical Power Distribution Co.—The directors report that, although the operations of the year 1912 were somewhat seriously affected by the national coal strike, which caused a lessened demand for current and a considerable increase in the price of coal, the units sold showed an increase of 5,319,081 over 1911, and reached a total of 19,689,656. After payment of all working expenses and interest on prior lien debenture stock, and making due provision for depreciation of new plant, there remains a fairly substantial surplus, which, according to agreement, will be utilised in discharging the indebtedness to certain consumers of the Treforest Co. The application last year for a prov. lighting order for the district of Llantwit Fardre was successful, and a supply is now being given in that district. The application for a prov. order for the district of Bedwas and Machen Upper is not at present being proceeded with. The supply of current in the Caerphilly area is developing satisfactorily, and the acquisition of the prov. order has been fully justified.

Australia.—An Australian exchange states that the Northern Sydney Electric Light and Power Supply Corporation, Ltd., has increased its capital to £250,000 by the creation of 230,000 shares of £1 each. This company has been negotiating with the North Sydney Council for the supply of electricity, and is also in communication with other Councils in the northern suburb for a like purpose.

Alldays & Onions Pneumatic Engineering Co., Ltd.—The directors announce a dividend at the rate of 5 per cent. per annum.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, March 26th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	per lb.	2¾d.	..
a „ Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	„	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£29 10	..
a Bleaching powder	„	£6 5	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£17 10	..
a Copper Sulphate	„	£28 15	..
a Lead, Nitrate	„	£29 10	..
a „ White Sugar	„	£27 10	..
a „ Peroxide	„	£32	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8¼d.	..
a Potash, Caustic (88/90 %) ..	per ton	£22 10	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide (98/100 %) .. (for mining purposes only)	„	7½d.	..
a Shellac	per cwt.	85/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70/72 %) ..	„	£10 5	..
a „ Chlorate	per lb.	3½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£95	..
b „ Wire, in ton lots (1 to 14 S.W.G.)	„	£112	..
b „ Sheet, in ton lots ..	„	£120	..
p Babbitt's metal ingots	„	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	6½d.	⅛d. dec.
c „ Tube (brazed)	„	7¼d.	¼d. dec.
c „ „ (solid drawn) ..	„	8¾d.	¼d. dec.
c „ Wire, basis	„	6¼d.	¼d. dec.
c Copper Tubes (brazed)	„	11½d.	¼d. dec.
c „ „ (solid drawn) ..	„	10⅝d.	¼d. dec.
g „ Bars (best selected) ..	per ton	£83	..
g „ Sheet	„	£83	..
g „ Rod	„	£83	..
d „ (Electrolytic) Bars ..	„	£69 15	..
d „ „ Sheets ..	„	£86 10	..
d „ „ Rods	„	£75	..
d „ „ H.C. Wire	per lb.	9¾d.	..
f Ebonite Rod	„	5/8	..
f „ Sheet	„	4/9	..
n German Silver Wire	„	1/10	..
h Gutta-percha, fine	„	7/- to 8/-	..
h India-rubber, Para fine	„	3/10½	1d. dec.
l Iron Pig (Cleveland warrants) ..	per ton	€5/6	2/6 inc.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Pig	„	£16 15	15s. inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£7 10	..
c Mica (in original cases) small ..	per lb.	6d. to 8s.	..
c „ „ „ medium	„	8/6 to 6/-	..
c „ „ „ large ..	„	7/6 to 11/-	..
o Nickel, sheet, wire, &c.	„	3/6 to 4/6 nom.	..
p Phosphor Bronze, plain castings	„	1/2 to 1/3½	¼d. dec.
p „ „ rolled bars & rods	„	1/2	..
p „ „ rolled strip & sheet	„	1/2½	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	11d.	..
r Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£217 to £218	£1 inc.
n „ Wire, Nos. 1 to 16	per lb.	2/7	1d. dec.
p White Anti-friction Metals ..	per ton	£45 to £228	..
k Zinc, Sh's (Vieille Montagne bnd.)	„	£28 10	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd
p
r W. F. Dennis & Co.

Greenock and Port Glasgow Tramways Co., Ltd.—The ordinary general meeting of the shareholders of the above company was held on March 18th, at Electrical Federation Offices, Kingsway, W.C., Mr. W. L. Madgen presiding. The proceedings were quite formal, the report being adopted on the motion of the Chairman, seconded by Mr. A. C. Miles, without any remarks.

Continental.—Switzerland.—La Société Suisse pour l'Industrie Electrique, of Basle, for the last financial year shows a profit of £69,350, as compared with only £50,865 in the preceding 12 months. A dividend of 7 per cent. is being declared.

Italy.—La Società Italiana Thomson-Houston, of Milan, is declaring a dividend of 6 per cent. for the last financial year.

STOCKS AND SHARES.

Tuesday Evening.

Holiday influences are still noticeable factors in the stock markets, and there was no great rush of fresh business for the Stock Exchange to cope with after the Easter recess. The situation abroad was read as more encouraging, and this pointed to the possibility of money becoming cheaper, so that to this extent conditions were to the good of markets. The wild weather of the week-end led to considerable damage to telephone and telegraph wires, but much of this had been repaired before the Stock Exchange resumed work on Tuesday morning.

The Underground Railway Companies should have been benefited at the expense of the steam lines by the roughness of the elements during the holidays. Judging by the traffic returns, however, people moved about at Easter-time with much the same freedom as usual. The Undergrounds, therefore, could not expect to receive more than their customary share of holiday traffic, and prices are a little duller, there being falls in Metropolitans and Districts. The Income Bonds of the Underground Electric Railways eased off to 92. No changes have taken place in Central London stocks, nor in those of the City and South London Railway, with the exception of a point fall in the City 4 per cent. Debenture stock. Metropolitan Electric Tramways First Debenture lost 1½. London United Tramways Debenture has not picked up its drop of last week.

The market for London Electricity Supply shares is well-nigh stagnant. Last week there was one change, and this week ties with its predecessor in the number of fluctuations, a fall of ⅛ in South Metropolitan Preference, reducing the price to 22s. 6d. Now that the dividends are declared and paid, and the reports issued, it is contended that there is nothing much else to go for at present; and, with the summer in front of us, the electric lighting companies of London will fall into their usual jogtrot, without exciting interest or attention from the investor. There is still a little speculation latent in the City of London Ordinary shares; and if the clique which has been operating in them were to choose to run up the price, the manœuvre could be executed without difficulty. In the provincial list, Bournemouth and Poole Second Preferences have hardened to 10⅛.

The Latin-Canadian group has somewhat weakened. Recent new issues from companies operating in South America have been left largely in the hands of underwriters, and this seems to have acted as a kind of caution signal in the way of checking purchases of American—North, Central, and South—stocks of the utility class. An important newcomer this week is the offer of three million dollars 5 per cent. Gold Bonds at 91 by the Mississippi River Power Company. The Common shares fell back to 48, but have recovered a point or so, while the existing 5 per cent. Bonds are quoted in the Stock Exchange Official List at 89½ to 91½.

Brazilian Traction dropped 1½ to 96½, and the British Columbia Electric stocks are lower. Havana Fives fell 2 points. Rio Trams 1st Bonds and Sao Paulo 1st Debentures are both a little lower. Of the Mexican descriptions, there are falls in Mexico tramway and Mexican Light and Power Shares and Bonds. The chief drop this week, however, is one of 5 points in Shawinigan water, where vague, unconfirmed rumours of an impending issue of new capital continue to play their part in depressing the price of the shares. Montreals gave way apparently in sympathy. Demand has arisen for Cape Electric Trams, the price putting on ⅛ at 15s. On the other hand, La Platas are ⅛ easier.

The Barcelona Tramway Company has recently made, we understand, an issue of 5 per cent. Bonds at 90, carrying a bonus of 33 per cent. in common shares. According to our information, it is intended to make a public issue of these Bonds later in the year, when the times are more propitious, the present emission being a kind of underwriting which enables the company to secure money and support at the time it wants them. The nominal price of Barcelona shares in the market is about 40. Columbia Gas and Electric shares have dropped back to 13, and the rest of the stocks and shares in this utility group are, on the whole, in a depressed state for the time being.

The Telegraph market is very quiet. Direct United States Cable shares dropped to 7, and Eastern Telegraph 4 per cent. Debenture at 96 is a point down. Other issues, however, retain the rises which they secured last week. New York Telephone Bonds are firmer, and National Telephone Deferred stock hardened to 20½ on a little speculative inquiry by those who expect that the residue of the money to be awarded will work out at something better than this.

A good deal of activity in Marconi's has for its net result a fall of ⅛ in the price of the Ordinary, and of ⅛ in the Preference. Whatever may be the ethical attitude which ought to be taken in respect of Cabinet Ministers' investments, the plain man will probably deplore the fact that highly placed officials should allow the least handle to be given to the suspicion that they should be speculating. And that American Marconi shares savoured strongly of a speculation there will be found few Stock Exchange men ready to deny.

The British Aluminium Company's report makes a fine showing, net profits having risen to £194,800, no less than £42,000 better than those for the corresponding period. Some such result had been expected, and advances in the company's stocks have been noticed here from time to time. This week there are improvements in the Ordinary and Preference shares. Brush Second Debenture lost 5 points, bringing the price down to 25. Manufacturing descriptions as a whole are very steady. Rubber shares eased off, but braced up again; the stationary condition of the market in the raw material is fatal to activity in the shares; probably the users of rubber appreciate it more than the Stock Exchange does.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Mar. 25th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5⅓	5†	9⅞ — 10⅛	..	5 4 9
Do. 4½ % Pref.	10	4½	4½	8¾ — 9¼	..	4 14 9
Do. Second 6 % Pref.	10	6	6	9⅞ — 10⅛	+ ⅛	5 15 8
Do. 4½ % Deb. Stock	Stock	4½	4½	96 — 98	..	4 11 10
Brompton & Kensington, Ord.	5	10	10	8⅞ — 9⅛	..	5 6 8
Do. 7 % Cum. Pref.	5	7	7	8¾ — 9	..	3 17 9
Central Electric Supply, 4 % Guar. Deb.	100	4	4	95 — 98	..	4 1 8
Charing Cross, West End & City	5	5	5†	4⅜ — 4⅞ xd	..	5 2 7
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	8¼ — 4⅜	..	5 2 10
Do. Do. 4 % Deb.	100	4	4	91½ — 93½	..	4 5 7
Chelsea, Ord.	5	5	4†	4⅜ — 5 xd	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	96 — 99	..	4 10 11
City of London, Ord.	10	8	9	16 — 17½ xd	..	5 2 10
Do. 8 % Cum. Pref.	10	6	6	12 — 13 xd	..	4 10 7
Do. 6 % Deb.	Stock	5	5	116 —120	..	4 3 4
Do. 4½ % Second Deb.	100	4½	4½	100 —102	..	4 8 3
County of London, Ord.	10	6	6	11 — 11½ xd	..	5 2 10
Do. 6 % Pref.	10	6	6	11½ — 12 xd	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	104 —106	..	4 4 11
Do. 4½ % Second Deb.	Stock	4½	4½	99 —102	..	4 8 8
Edmundson's, Ord.	£3	Nil	..	⅛ — ¼	..	Nil
Do. 8 % Cum. Pref.	5	Nil	.3	4¼ — 4½	..	..
Do. 6% Non-Cum. Pref.	5	..	..	1⅜ — 1⅝	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	81 — 84	..	5 7 2
Folkestone	5	6	6	4⅝ — 5⅛	..	5 17 1
Do. 5 % Cum. Pref.	5	5	5	4⅜ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	90 — 92	..	4 12 10
Hove	5	9	8†	7⅞ — 8	..	5 12 6
Kensington & Knightsbridge, Ord	5	9	8†	7⅛ — 8 xd	..	5 12 6
Do. 4 % Deb.	Stock	4	4	90 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	76 — 80	..	5 12 6
London Electric, Ord.	9	2½	..	1⅜ — 1⅞ xd	..	4 0 0
Do. 6 % Pref.	5	6	6	4⅜ — 5⅛ xd	..	5 14 3
Do. 4 % First Mort. Deb.	Stock	4	4	90 — 93	..	4 6 0
Metropolitan	5	4	4†	3⅞ — 4	..	5 0 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 17 4
Do. 4½ % First Mort. Deb.	Stock	4½	4½	97 —100	..	4 10 0
Do. 3½ % Mort. Deb.	Stock	3½	3½	84 — 86	..	4 1 5
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	98 —101	..	4 9 1
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	4⅜ — 4⅝	..	5 2 7
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99½ —102½	..	4 17 7
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9⅜ — 10⅜	..	5 11 7
Oxford	5	7½	6†	5¼ — 6⅜ xd	..	5 13 9
St. James' and Pall Mall, Ord.	5	10	10†	8⅜ — 9	..	5 11 1
Do. 7 % Pref.	5	7	7	6⅜ — 7⅛	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	84 — 87	..	4 0 6
Smithfield Markets, Ord.	5	2	2	⅞ — 1⅛	..	..
South London, Ord.	5	5	..	3 — 3⅜	..	5 18 6
Do. 5 % First Mort. Deb.	100	5	5	97 —100	..	5 0 0
South Metropolitan, 7 % Pref.	1	7	7	1 1/16 — 1 1/8	—1/32	5 17 11
Do. 4½ % First Deb. Stock	100	4½	4½	96 — 99	..	4 11 3
Urban, Ord.	£3	Nil	..	⅛ — ¼	..	..
Do. 5 % Cum. Pref.	5	2	..	2⅛ — 2⅜	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	85 — 88	..	5 2 3
Westminster, Ord.	5	10	10	8⅜ — 8⅝	..	5 12 8
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 5⅛	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5 — 5⅛	..	5 14 3
Calcutta, Ord.	5	8½	7†	6¾ — 7	..	6 1 5
Do. 5 % Pref.	5	5	5	4⅜ — 5⅛	..	4 17 7
Calgary Power, 1st Mort. Bds.	100	5	5	92 — 94	..	5 6 5
Canadian Gen. El. Com.	$100	7	7	115 —119	..	5 17 8
Do. 7 % Pref.	$100	7	7	120 —124	..	5 13 0
Cordoba Lt., Power and T., Ord.	1	3	..	1⅛ — ⅞	..	5 14 3
Do. 5 % Deb.	100	5	5	96 — 99	..	5 1 0
Elec. Lt. and P. of Cechabamba, 7 % Bonds	100	6	6	93 — 95	..	6 6 4
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	90 — 93	..	5 7 6
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	93 — 95	..	5 5 3
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	⅛ — ⅜	..	Nil
Do. 6 % Pref.	1	6	6	⅞ — 1	..	9 15 2
Kaministiquia Power, 5% G. Bs.	$500	5	5	101½—103½	..	4 16 7
Madras, Ord.	5	Nil	..	1⅛ — 1¼	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	101 —104	..	4 16 2
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	81 — 84	..	5 19 0
Mexican Lt. & Power, Common	$100	4	4†	76 — 79	—1	5 1 3
Do. 7 % Cum. Pref.	$100	7	7	100 —104	..	6 14 7
Do. 5 % 1st Mort. Gold Bds.	..	5	5	91 — 93	—2	5 7 6
Monterey Rly. Light & Power, 6 % 1st Mort. Deb.	100	5	5	82 — 85	...	5 17 8
Montreal, Lt., H. and Power	$100	8	9†	222 —227	—3	3 19 4
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5a	10 — 20	..	..
River Plate, Ord.	Stock	10	..	217 —227	..	4 8 0
Do. 6 % Non-Cum. Pref.	Do.	6	6	105 —110	..	5 9 1
Do. 5 % Deb. Stock	Do.	5	5	100 —102	..	4 18 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	5	5	138 —136	+5½	3 13 6
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —102	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	101 —103	..	4 7 5
Toronto Power, 4½ % Deb.	Do.	4½	4½	97½ — 99½	—1	4 10 6
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	91 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	11½d.	17½d.	13/16 — 15/16	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	106 —108	..	5 11 1

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	4	4½†	7 — 7½	..	6 0 0
Do. 5 % Deb. Red.	Stock	5	5	97 — 99	..	5 1 0
American Telep. & Teleg., Cap.	$100	8	8†	135 —137	+1	5 16 10
Do. Collat. Trust	$1000	4	4	90 — 92	..	4 7 0
Anglo-American Telegraph	Stock	8	8	65½ — 67½	..	4 9 0
Do. 6 % Pref.	Do.	6	6	111 —112	..	5 7 2
Do. Def.	Do.	80/-	..	24⅜ — 24⅝	—⅛	6 1 10
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	99½ —101½	..	4 18 6
Chili Telephone	5	7	8	7 1/16 — 7 1/8	..	5 1 1
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	80 — 82	..	4 17 7
Cuba Telegraph	10	6	6†	8¾ — 9½	..	6 0 9
Do. 10 % Pref.	10	10	10	16 — 17	..	5 17 8
Direct Spanish Telegraph, Ord.	5	4	4†	3½ — 3⅝	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	6¾ — 7	..	7 2 10
Direct United States Cable	10	5	4	6½ — 7½	— ½	5 10 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101	..	4 9 0
Eastern Telegraph, Ord. Stock	Stock	7	7†	134 —137	..	5 2 2
Do. 3½ % Pref. Stock	Do.	3½	3½	78½ — 80½	..	4 6 11
Do. 4 % Mort. Deb.	Do.	4	4	93 — 97	—1	4 2 6
Eastern Extension	10	7	7†	12⅜ — 13⅜	..	5 4 8
Do. 4 % Deb.	Stock	4	4	96 — 97	..	4 2 6
East and S. Africa Tel. 4 % Mtg. Db. Mauritius Sub.	25	4	4	98 —101	..	3 19 8
Globe Telegraph and Trust	10	6	6†	10⅝ — 11½ xd	..	5 7 10
Do. 5 % Pref.	10	6	6	12¾ — 13	..	4 12 4
Great Northern Telegraph	10	18	18	29 — 31	..	5 14 8
Indo-European Telegraph	25	13	6†	58 — 60	..	5 8 4
Mackay Companies Common	100	5	5	80 — 82 xd	..	6 2 0
Do. 4 % Cum. Pref.	$100	4	4	67 — 69 xd	..	5 16 0
Marconi's Wireless Telegraph	1	20	..	4¼ — 4⅜	—⅛	4 14 1
Do. 7 % Cum. Partic. Pref.	1	17	..	8¼ — 8½	— ⅛	4 10 8
Monte Video Telephone, Ord.	1	6	6†	1⅜ — 1 1/16	..	5 18 0
Do. 5 % Pref.	1	5	5	⅞ — 1	..	5 14 8
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	93½ — 95½	+ ½	4 10 8
Oriental Telep. and Elec.	1	6	6†	1⅜ — 1⅝	..	4 7 0
Do. 6 % Cum. Pref.	1	6	6	1⅜ — 1⅝	..	4 18 6
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 8 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	97½ — 99½	..	4 0 5
Reuter's	10	10	10†	11⅛ — 11⅜	..	8 10 2
Do. New Shares	10	..	..	10 3/16 — 11 1/16	..	..
Submarine Cables Trust	Cert.	6	6	127 —130	..	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	96 — 98	..	4 11 10
United River Plate Telephone	5	8	..	7⅜ — 7⅝	..	5 4 11
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 9 0
West Coast of America	2½	2½	..	1⅛ — 1⅜	..	4 3 4
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	96 — 98	..	4 1 8
West India and Panama Teleg.	10	2½	1½†	2¼ —	..	..
Do. 6 % Cum. 1st Pref.	10	6	6	10 —	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9⅜ —	..	6 0 0
Do. 5 % Debs.	100	5	5	101 —108	..	4 17 1
Western Telegraph, Ltd.	10	7	7½	13 — 13½ xd	..	5 3 8
Do. 4 % Deb.	Stock	4	4	95 — 97	..	4 2 6
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	97½ —100½	..	4 10 0

*Unless otherwise stated, all shares are fully paid. a Paid in deferred interest warrants. † Interim Dividend. ‡ 3s. in Funded Dividend Certs.

CONTINUED ON NEXT PAGE

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Mar. 25th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	*					
Do. 5 % Pref.	1	Nil	Nil	3/32 — 5/32	..	Nil
Do. 4½ % Deb.	1	5	5	11/16 — 13/16	..	6 8 1
Brit. Elec. Trac., 6 % Pref.	100	4½	4½	76 — 81	..	5 11 1
Do. Deferred	100	..	..	9 — 11	..	..
Do. Do. 6 % Cum. Pr'f.	100	..	..	3½ — 5½	..	..
Do. 7 % Non-Cum. Pr'f.	100	6	6	85/8 — 88/8	..	6 15 7
Do. 5 % Perp. Deb.	100	..	..	85 — 38	..	..
Do. 4½ % 2nd Deb.	100	5	5	91 — 95	..	5 5 3
Central London Railway, Ord.	100	4½	4½	75 — 79	−2	5 13 11
Do. Pref.	100	8	8	78 — 80	..	5 0 0
Do. Def.	100	4	4	83 — 85	..	4 14 2
Do. 4 % Deb.	100	2	2	78 — 80	..	5 0 0
City & S. London, 5 % Pref., 1891	100	4	4	98 —100	..	4 0 0
Do. Do. 1896	100	5	5	99 —102	..	4 18 0
Do. Do. 1901	100	5	5	99 —102	..	4 18 0
Do. Do. 1903	100	5	5	97 —100	..	5 0 0
Do. 4 % Deb.	100	5	5	95 — 98	..	5 2 0
Dublin United Trams, 6 % Pref.	100	4	4	96 — 98	−1	4 1 8
Great Northern & City, Pr'f. Ord	10	6	6	11¾ — 12¾	..	4 18 0
Hastings Trams, 6 % Pref.	10	Nil	Nil	2/8 — 2/8	..	Nil
Do. 4½ % Deb.	1	6	6†	7/16 — 9/16	..	7 7 8
Isle of Thanet Trams, 5 % Pref.	100	4½	4½	69 — 74	..	6 1 7
Do. 4 % Deb.	5	2½	2½	2½ — 2⅝	..	4 15 3
Lancashire United, 5 % Deb.	100	4	4	75 — 80	..	5 0 0
London Elec. Railw'ys, 4 % Deb.	100	5	5	78 — 80	..	6 5 0
London United Trams, 5 % Pref.	100	4	4	94 — 96	..	4 3 4
Do. 4 % Deb.	10	Nil	..	4½ — 5	..	..
	100	4	4	65 — 69	..	5 16 0

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Mar. 25th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	*					
Do. Surplus Lands	100	1⅞	1⅝	50½ — 51	− ⅛	3 3
Do. 5 % Deb.	100	2⅞	2⅞†	61 — 63	..	4 6 0
Do. 4½ % Pref.	100	3½	3½	84 — 86	..	4 1 5
Do. 4½ % Con. Pref.	100	3½	3½	82 — 84	..	4 3 4
Metropolitan District Ord.	100	3½	3½	81 — 83	..	4 4 4
Do. 6 % Deb.	100	Nil	Nil	38 — 38½	..	Nil
Do. 4 % Deb.	100	6	6	135 —137	..	4 7 7
Do. 4 % Prior Lien	100	4	4	93 — 95	..	4 2 6
Do. 4½ % First Pref.	100	4	4	98 —100	..	3 19 8
Do. 4½ % Gtd.	100	4½	4½	85 — 87	..	5 1 2
Metropolitan Elec. Trams, Ord.	100	3½	3½	75 — 77	..	4 10 11
Do. 5 % Pref.	1	6	5†	33/32 — 1 1/32	..	5 18 6
Do. 4½ % Deb.	1	5	5	7/16 — 1/2	..	6 3 1
Potteries, Ord.	100	4½	4½	87 — 91	−1½	4 18 11
Do. 5 % Pref.	1	5	5	15/16 — 31/32	..	5 3 1
Do. 5 % Deb.	100	5	5	94 — 97	..	..
South Metro. Trams, 6 % Pref.	1	6	..	5/16 — 7/16	..	..
Do. 4 % Deb.	100	4	4	65 — 70	..	6 19 0
Underground Elec. Railways	10	..	..	4⅛ — 4⅜	..	5 2 3
Do. "A"	1/-	..	..	1/32 — 3/32	..	7 7 8
Do. 6% First Cum. Inc. Deb.	100	..	6	109 —111	..	Nil
Do. 4½ % Bonds	100	4½	4½	97 — 99	−1	5 9 1
Do. 6 % Income	100	1½	6 †	91½ — 92½	− ½	4 10 11
Yorkshire (West Riding), Ord.	5	Nil	..	1/16 — 3/16	..	6 9 9
Do. 6 % Pref.	5	3	3†	2⅛ — 2⅜	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 84	..	4 12 4
						5 7 2

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5⅜	4 13/32 — 5 1/16	..	5 8 7
Do. 2nd Pref.	5	5½	5⅜	4 9/16 — 4 11/16	..	5 14 8
Do. 4 % Deb.	100	4	4	90½ — 92½	..	4 6 6
Do. 4½ % Deb.	100	4½	4½	88 —100	— ½	4 10 0
Do. 5 % Deb.	100	5	5	98 —100	..	5 0 0
Auckland Trams, 5 % Deb.	100	5	5	101 —103	..	4 17 1
Bombay Elec. S. & Trams, Pref.	10	6	6	11 — 11⅜	..	5 2 2
Do. 4½ % Deb.	100	4½	4½	96 — 98	..	4 11 10
Do. 5 % 2nd Deb.	100	5	5	97 — 99	..	5 1 0
Brazilian Traction Light and Power	$100	..	6†	95½ — 97½	−1½	..
Brisbane Trams Invt., Ord.	5	8	8†	7⅛ — 7⅜	..	5 5 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 15 8
Do. 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5
B. Columbia Elec. Rly., Def.	100	8	..	131 —136	−2	5 17 8
Do. Pref. Ord.	100	6	6	112 —117	−1	5 2 7
Do. 5 % Pref.	100	5	5	103 —106	..	4 14 4
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	100 —102	−1	4 8 3
Do. 4½ % Con. Deb.	100	4½	4½	95 — 97 xd	..	4 7 8
Calcutta Trams, Ord.	5	7	5†	5⅜ — 6⅛	..	5 12 0
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16	..	4 17 7
Do. 4½ % Deb.	100	4½	4½	97⅜ —100⅜	..	4 9 7
Cape Electric Trams	1	2½	..	1 1/16 — 1 3/16	+ 1/16	..
City Buenos Aires Trams (1904)	5	5	5†	5 7/16 — 5 11/16	..	4 8 0
Do. 4 % Deb.	100	5	5	97 —100	..	5 0 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 97	..	5 2 1
Havana Elec. Rly., 5 % Bonds	$1000	5	5	97 —101	−2	4 19 0
Kalgoorlie Elec. Trams	1	Nil	..	5/16 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	89 — 88	..	5 13 8
Do. 6 % B Deb.	100	6	3	25 — 35	..	..

La Plata Elec. Trms, Ord.	1	Nil	..	13/32 — 13/32	— 1/32	..
Do. Pref.	1	6	..	29/32 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1⅛ — 1⅜	..	4 7 3
Do. 6 % Pref.	1	6	6	1 — 1¼	..	4 16 0
Do. 5 % Deb.	100	5	5	£2 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	102 —104	..	4 16 2
Manaos Trams & Lt., 1st Deb.	100	5	5	87 — 90	..	5 11 1
Manila Elec. R. and Ltg., Bonds	$1000	5	5	98 —100	..	5 0 0
Mexico Trams Com.	$100	7	7†	107 —110	—1	6 7 3
Do. Gen. Con. 5 % Bonds	..	5	5	90 — 92	— ½	5 8 8
Do. 6 % Bonds	100	6	6	95 — 99	— ½	6 1 3
Para Elec. Rlys. & Lt., Ord.	5	10	10	6⅞ — 7⅛ xd	..	6 15 7
Do. 6 % Pref.	5	6	6	4⅞ — 5⅛ xd	+ ⅛	5 14 3
Do. 5 % 1st Deb.	100	5	5	99 —101	..	4 19 0
Perth (W.A.) Elec. Tr., Ord.	1	5	5½	1 3/16 — 1 1/16	..	3 14 5
Do. 5 % 1st. Deb.	100	5	5	105 —108	..	4 12 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅞	..	5 0 0
Do. 4½ % 1st Deb.	100	4½	4½	97 — 99	..	4 10 11
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	100¾ —101¾	— ½	4 18 3
Do. 5 % Mort. Bonds	100	5	5	96 — 97	..	5 3 1
Sao Paulo Tram, Lt. and P. 5 % 1st Deb.	$500	5	5	101½ —103½	— ½	4 16. 7
Singapore Trams, 5 % Deb.	100	5	5	86 — 90	..	5 11 1
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95½ — 97½	..	5 2 7
Un. Elec. Trams Monte Video	5	7	6†	5 — 5⅛	— ⅛	6 7 3
Do. 6 % Pref.	5	6	6	4¾ — 5⅛	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	98 —101	..	4 19 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	98½ —101½ xd	..	4 8 8

MANUFACTURING COMPANIES.

Aron, Ord.	1	6	..	1/32 — 3/32	..	8 0 0
Do. 6 % Pref.	1	6	6	29/32 — 31/32	..	7 2 2
Babcock & Wilcox	1	28	14†	31/32 — 1	..	4 0 0
Do. Pref.	1	6	6	1 1/32 — 1 1/16	..	4 0 0
British Aluminium, Ord.	1	Nil	..	13/32 — 15/32	+ 1/16	..
Do. 6 % Cum. Pref.	1	Nil	..	7/8 — 15/16	+ 1/32	..
Do. 5 % Prior Lien Debs.	100	5	5	91 — 94	..	5 6 5
Do. Deb. Stk.	100	5	5	87 — 90	..	5 11 1
B.I. & Helsby Cables	5	10	8†	8⅛ — 8⅜	..	5 15 11
Do. Pref.	5	6	6	5⅞ — 6⅛	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	96 — 98	..	4 11 10
British Westinghouse, Pref.	8	Nil	Nil	7/16 — 11/16	..	Nil
Do. Deb.	100	4	4	58 — 61	..	6 11 2
Do. 6 % Prior Lien	100	6	6	100 —103	..	5 16 6
Browett, Lindley, Ord.	1	..	..	2/- —3/-	..	Nil
Do. Pref.	1	..	..	4/6 —5/-	..	Nil
Brush, 7 % Pref.	2	Nil	Nil	0 — ½	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	73 — 78	..	6 8 2
Do. 4½ % Deb	100	4½	4½	88 — 43	..	10 9 4
Do. 4½ % Second Deb.	100	4½	4½	23 — 27	—5	16 13 4
Callender's Cable	5	15	10†	11 — 11⅜	+ ½	6 7 8
Do. Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Castner-Kellner	1	20	20	31 9/32 — 33 3/32	— 1/16	5 7 9
Do. Deb.	100	4½	4½	103 —106	..	4 4 11

Crompton & Co.	3	Nil	..	1/16 — 3/32	..	Nil
Do. Deb.	100	5	5	55 — 57	..	9 15 6
Dick, Kerr	1	5	Nil	3/32 — 5/32	..	..
Do. Pref.	1	6	6	1 1/16 — 1 3/16	..	7 7 8
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £8 paid	5	Nil	..	1/16 — 3/32	..	Nil
Do. fully paid	5	Nil	..	1/16 — 1/32	..	Nil
Do. 4 % Deb.	100	4	4	61 — 65	..	6 3 1
Do. 5 % Second Deb.	100	5	5	72 — 75	..	6 18 4
Electric Construction	2	2½	3⅜	1 1/32 — 1 1/16	..	5 14 4
Do. Pref.	2	7	7	1 29/32 — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7¼ — 8	..	8 5 8
Do. Deb.	100	5	5	92 — 94	..	5 4 2
General Electric, Pref.	10	5	5	10 — 10⅜	..	4 13 0
Do. Deb.	100	4	4	90 — 95	..	4 4 3
Henley's, Ord.	5	15	15	12½ — 13 xd	..	5 15 5
Do. Pref.	5	4½	4½	4⅛ — 5⅛ xd	..	4 7 10
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	10	..	7½	10 — 11	..	6 16 4
Do. Pref.	10	5	5	9 — 10	..	5 0 0
Telegraph Construction	12	17½	17½	84 — 86 xd	..	5 16 8
Do. Deb.	100	4	4	95½ — 98½	..	4 1 3
Willans & Robinson	1	Nil	..	1/16 — 1/8	..	Nil
Do. Pref.	5	Nil	..	1/32 — 1/16	..	Nil
Do. Deb.	100	4	4	57 — 59	..	6 15 7

* Unless otherwise stated, all shares are fully paid. † Interim dividend. ‡ Dividend of 4 per cent. guaranteed by Underground Electric Railways.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1913.

THE February returns of electrical business show a falling off in both the export and import sections as compared with the previous month, which is to some extent accounted for by the shorter period covered by the returns.

The exports from this country reached a total of £517,375, as compared with £576,523 in the previous month, and included nearly £170,000 worth of machinery and cable valued at £106,711.

The telegraphic and telephonic exports, although, in common with other things, showing some decrease on the January figures, reached very satisfactory totals.

Electrical imports were valued at £236,079, as against £252,167 in January; while the re-exports at £23,396, were about £5,000 down. The decrease in the imports total was mainly due to the falling off in cable, telegraphic and telephonic values, the other items of the imports showing but little variation in value as compared with the January returns.

Argentina was our best customer during the month, while India, New South Wales, Canada and Brazil were also prominent purchasers from this country.

As regards the imports, Germany, as usual, took the lion's share of the business, while the United States retained a large share of the remainder.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable, and apparatus and electric bells	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,015	332	144	39	...	190	2,199	32	18	...	583	367	5,919
Germany	1,733	210	8	...	514	489	1,947	...	2	3	2	48	4,956
Netherlands, Java & Dutch Indies	735	1,408	98	...	220	215	870	30	306	35	35	168	4,120
Belgium	487	262	39	70	273	...	1,400	347	14	60	1,190	...	4,142
France	607	133	3,233	40	30	273	10,107	92	12	83	32	3	14,645
Portugal	191	...	23	...	...	...	404	...	10	6	250	25	909
Spain, Canary Isles and Spanish N. Africa...	1,064	1,908	9	138	300	350	5,170	914	72	129	694	402	11,150
Switzerland, Italy and Austria-Hungary ...	301	270	203	62	69	14	2,423	...	7	256	45	1,680	5,328
Greece and Turkey	402	2,996	16	...	...	...	1,800	...	101	32	...	250	5,597
Channel Isles, Gibraltar, Malta and Cyprus...	239	38	73	44	...	36	375	950	1,450	...	19	658	3,882
U.S.A., Philippines and Cuba	807	15	524	...	64	286	317	...	11	10	2	1,103	3,139
Canada and Newfoundland	1,099	6,625	1,174	581	20	4,853	12,438	...	4,134	49	5,158	186	36,317
British West Indies and British Guiana ...	50	54	73	96	...	88	187	4	132	...	12	198	894
Mexico and Central America	91	...	26	...	34	...	160	59	...	...	12	83	465
Peru and Uruguay	454	...	137	58	...	12	484	...	1,339	20	44	1,264	3,812
Chile	591	106	307	57	...	17	7,564	927	678	...	278	4,543	15,068
Brazil	1,471	2,972	2,312	322	25	75	10,189	467	214	...	12,483	2,540	33,070
Argentina	3,823	26,426	379	1,628	90	526	15,284	2,617	3,296	238	7,643	624	62,574
Colombia, Venezuela, Ecuador and Bolivia...	...	28	5	...	...	...	598	...	7	4	...	390	1,032
Egypt, Tunis and Persia	607	286	46	39	11	44	1,308	56	55	...	493	18,148	21,093
British West Africa and Ascension	387	51	7	204	154	...	1,502	...	5	38	145	...	2,493
Rhodesia, O.R.C. and Transvaal	1,145	186	475	1,028	154	256	2,186	770	226	11	217	...	6,654
Cape of Good Hope	1,959	1,273	173	384	...	2	2,772	245	1,097	20	4,611	28	12,564
Natal	813	9,640	570	209	...	173	5,097	52	152	...	181	92	16,979
Zanzibar, Brit. E. Africa, Mauritius & Aden	82	394	16	126	...	...	461	44	7	...	8	593	1,731
Azores, Madeira and Portuguese Africa ...	565	262	37	51	...	136	1,044	4	85	...	138	10	2,332
French African Colonies and Madagascar ...	...	...	32	...	...	...	...	...	...	...	17	15,100	15,149
China and Siam	1,118	432	185	224	...	1,421	4,994	46	1,429	...	86	357	10,292
Japan and Korea	518	4,890	917	—	26	2,259	12,475	...	3,474	...	94	105	24,788
India	3,970	18,560	3,035	1,686	112	2,246	12,354	3,268	3,008	64	823	734	49,860
Ceylon	101	2,474	108	25	...	761	144	...	2	4	108	166	3,893
Straits Settlements, and Fed. Malay States	377	1,696	249	43	...	201	662	194	181	136	29	17,166	20,934
Hong Kong	245	154	372	267	...	...	697	...	408	...	21	80	2,244
West Australia	354	1,106	393	644	...	228	4,352	1,652	1,761	...	...	459	10,949
South Australia	643	906	115	367	23	684	1,407	...	...	...	...	...	4,145
Victoria	3,465	7,095	914	1,434	...	157	5,363	1,779	42	...	6,184	677	27,110
New South Wales	3,738	9,700	1,290	506	95	1,582	15,370	1,235	1,241	20	10,701	2,302	47,780
Queensland	68	516	123	401	...	162	1,644	...	46	72	22	...	3,054
Tasmania	167	14	7	95	...	...	60	...	77	...	377	275	1,072
New Zealand and Fiji Islands	2,350	3,293	578	1,014	...	1,038	5,305	436	209	4	499	514	15,240
Total, £	38,862	106,711	18,425	11,882	2,214	18,774	153,113	16,220	25,308	1,294	53,234	71,338	517,375

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	7	...	...	70	...	...	4,058	291	523	...	5,166	10,115
Germany	8,623	23,759	1,963	15,943	7,978	3,731	70,272	234	2,637	8,055	6,460	149,655
Holland	...	...	130	3,469	760	7	336	...	...	5	38	4,745
Belgium	779	1,309	149	239	84	...	2,196	10	361	258	5,256	10,641
France	591	...	646	1,340	369	622	768	100	269	3,691	1,328	9,724
Switzerland	257	332	156	38	26	136	820	12	...	56	735	2,568
Italy	521	4,703	...	...	...	...	108	...	...	...	200	5,532
Austria-Hungary	...	798	...	593	102	...	24	...	...	747	148	2,412
United States	5,508	765	865	130	870	55	10,458	21,251	...	3	441	40,346
Canada	28	...	15	...	...	...	40	...	...	...	...	83
Total, £	16,314	31,666	3,924	21,822	10,189	4,551	89,080	21,898	3,790	12,815	19,772	235,821

Additional imports: Spain, carbon, £258.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above ...	8,396	204	...	4,391	481	...	8,859	...	446	524	95	23,396

TOTAL EXPORTS: £517,375. TOTAL RE-EXPORTS: £23,396. TOTAL IMPORTS: £236,079.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

PROCEEDINGS OF INSTITUTIONS.

Power Supply on the Rand.

By A. E. Hadley, M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers, *at Manchester, March 11th, and in London, March 13th, 1913. For the commencement of the paper see p. 519.)*

The 80,000-volt pole line consists of two rows of lattice steel masts equipped with four circuits of stranded copper, each conductor having a section of 60 sq. mm., and carrying three earthed guard wires above the conductors. Every fourth mast (commonly called an "anchor mast," fig. 1) is of sufficient strength to take the full strain of the conductors in a lateral direction; and the three intermediate masts (fig. 2) are designed to take the strain due to wind

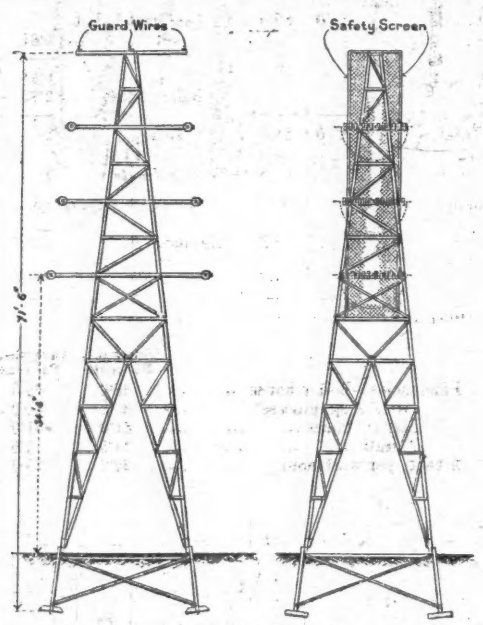


Fig. 1.

pressure in a direction transverse to the line. Extra anchor masts are also used whenever the line changes its direction, and at railway crossings. A special end tower (fig. 3) is used at the ends of the line.

The masts are normally spaced 500 ft. apart. The anchor masts have an overall height of 71 ft. 6 in., the lowest cross-arm being 34 ft. 6 in. from the ground. On these masts the conductors are placed

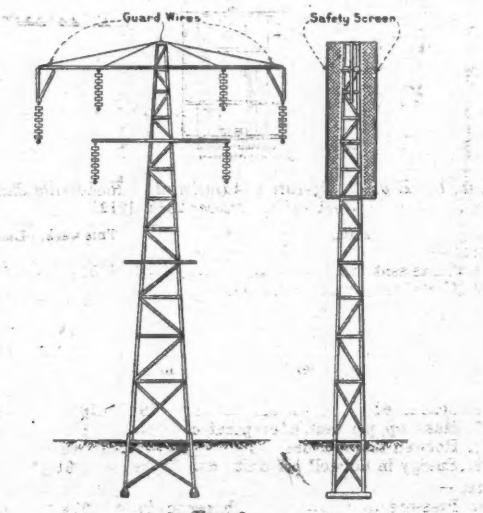


Fig. 2.

vertically above each other, separated by a distance of 9 ft. Each mast was required to deflect ½ in. at the top when subjected to a horizontal pull of 4½ tons applied 44 ft. from the ground at an angle of 30° from the line direction.

The intermediate masts when carrying the weight of the insulators, conductors and guard wires, were required to give a temporary deflection at the top of ½ in. when subject to a horizontal pull of 35 cwt., applied 35 ft. from the ground and at right angles to the line direction. The conductors on these masts are arranged three on each side, in the shape of an equilateral triangle having sides 8 ft. long. The lowest support for the conductors is 34 ft. 6 in. from the ground, and a 10-ft. sag is allowed, so that the lowest part of any conductor is never less than 24 ft. 6 in. from the ground. All masts are provided with a safety screen to prevent any possibility of men working on one circuit coming into contact with the circuit on the opposite side of the pole. This screen consists of a rectangular steel framework interlaced with galvanised steel wire netting.

The 80,000-volt insulators used are of the disk type, 10 in. in diameter, and connected six in series at each suspension and straining point. Before erection each insulator is subjected to a mechanical stress of 1½ tons, and while in this condition is tested to 60,000 volts for five minutes.

The latest type of 40,000-volt transmission line is of a similar design, but pin insulators are employed on the intermediate lattice masts, and four disks are used in each string of insulators on the main towers which take the lateral strain.

All the 20,000-volt cables have circular conductors of 100 sq. mm. section, and are paper-insulated, lead-covered and armoured. Each cable is capable of transmitting about 7,000 K.V.A. The cable was specified to stand a test pressure at the factory of 50,000 volts, and a test pressure of 40,000 volts for 10 minutes after laying.

The atmospheric conditions on the Rand are in many ways abnormal. During the winter violent wind and dust storms are encountered, while for six months during the summer (from September to April) the reef is the centre of frequent and violent lightning storms accompanied by heavy rain and sometimes phenomenal hail. The Rand, which is the watershed of that part of South Africa, is probably about the worst district in the world for lightning, the altitude of Johannesburg being 5,760 ft. At this altitude the range of temperature is very large, and rapid changes in temperature occur, disturbing the atmospheric conditions.

The total number of lightning storms passing over different sections of the system during the last season (which lasted for 182 days) amounted to 199. Most careful daily records and observations are taken of all atmospheric disturbances, and these records show that lightning is encountered on an average on one out of every three days.

Every storm exerts some influence of greater or lesser severity upon the overhead system, but year by year the number of troubles caused have been largely reduced, so that interruptions to supply are now infrequent, and the loss of apparatus seldom takes place.

As a general rule the effect of lightning is brought about through an induced effect on the overhead lines, setting up a high-frequency surge. Experience goes to prove that the intensity

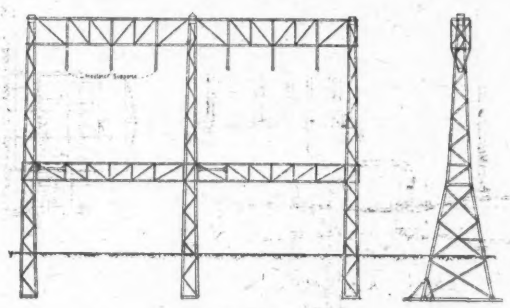


Fig. 3.

of the induced effect is in the majority of cases localised to some part of the transmission line, and only in the minority of cases does it reach the end of the line with its full severity. Further, it is quite a rare though not unknown occurrence for the line to be actually struck by lightning; and it is possible, though not determined, that this immunity may be the result of the earthed guard wires.

The means whereby the effects of lightning have been prevented in the great majority of cases from disturbing the system are mainly; (*a*) the employment of earthed overhead-guard wires; (*b*) earthing the neutral of each separate section of the system; and (*c*) by careful selection and adjustment of lightning arresters to deal with the different conditions arising.

Experience has shown that the guard wire constitutes one of the most efficient systems of line protection, and contributes largely to successful operation during storms.

During the earlier lightning seasons the neutral of the system was not earthed, and unquestionably many interruptions and much loss of apparatus resulted from not employing this system. One of the troubles caused by lightning is occasioned by the arcing-over of insulators, which with an insulated system having considerable capacity to earth generally results in an intermittent arc to earth, thereby setting up dangerous surges in the system. These surges lead to cumulative trouble and cause discharges on the arresters of the other two phases, increasing in severity until finally a second flash-over takes place (generally at the arrester gear itself) and short-circuits the phases. By earthing the neutral through a resistance, any arc to earth is immediately isolated by the operation of the Merz-Price balanced relay system, and the arresters are not called upon to continue operating. A star-delta transformer is employed for earthing to avoid disturbance to telephones. Since the neutral of the system was earthed, it has been

found that in the majority of cases where an arc has occurred over a line insulator, the fault has been isolated so rapidly as to prevent damage to the insulator, and the line has been immediately put back into service by closing the switches.

At the time of the initial installation the aluminium arrester was not on the market, and in consequence, a complete system of horn arresters was connected up. The most careful records have since been kept of the operation and discharges occurring on these arresters. The number of pressure rises on each of the phases with an earthed neutral has been found to be equal.

The best combination of the number of horns, the spacing of arc gaps, and the amount of resistance to earth, had to be determined by experience and experiment.

During last season some aluminium arresters were installed, but no conclusive observations of their operations were obtained. This system, however, has been adopted for the protection of the 80,000-volt lines, as the experience on many systems in America has been largely in favour of this form of protection.

In order to show the operating efficiency, technical figures such as are regularly used by this company, rather than financial figures, are put forward in this paper.

As they participate in the profits, the consumers supplied by the company have at definite periods the right of access to the books in order to determine the cost of a unit of power.

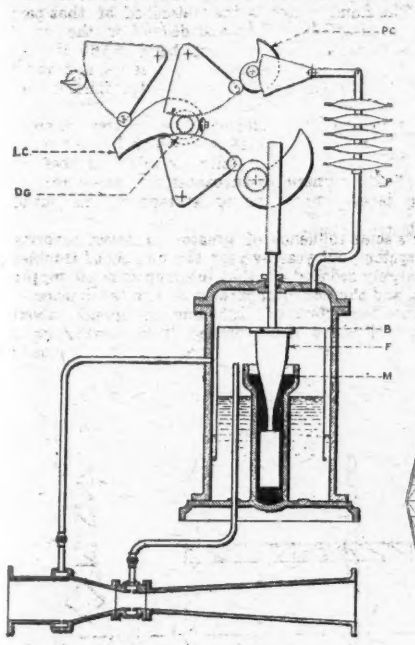


FIG. 4.—AIR METER.

The supervision of the power stations by the administration is based on weekly balance-sheets from each station, showing the efficiency of each process. The form in which these returns are made is based upon the underlying idea of energy, and all energy in whatever form it appears, whether as heat in the coal or in the steam, is expressed in the electrical engineer's unit, *i.e.*, the kilowatt-hour, which proves far more convenient than using foot-pounds or thermal units for expressing energy. The energy value of each lb. of coal, usually expressed in B.TH.U., is converted to kilowatt-hours by multiplying by 0·000293; thus, a coal of 11,300 B.TH.U. per lb. has a value of 3·3 KW.-hours per lb.

The product of the number of lbs. of coal burnt per KW.-hour, and the energy value per lb. gives the coal energy required for each unit of electrical energy sent out; and the reciprocal of this multiplied by 100 gives the overall efficiency of the station. Thus, taking an average figure for Rosherville of 2½ lb. of coal per unit sent out, and 3·3 KW.-hours (11,300 B.TH.U.) for the heat value of the coal per lb., the overall efficiency is 12 per cent.

In a similar manner the energy in the steam is calculated in kilowattt-hours from Mollier's steam tables. The boiler efficiency is the ratio of the kilowatt-hours in the steam (less the energy supplied from the hot well) to the kilowatt-hours in the coal. The efficiency of the engine room plant is expressed as the ratio of 1 KW.-hour of electrical output to the kilowatt-hours of available energy in the steam, *i.e.*, to the total energy of the steam less the heat rejected to the condensers. The ratio of the available energy in the steam to the total energy in the steam gives a measure of the efficiency of the condensing process.

The balance-sheet and detailed report of the Rosherville station show how the returns of these efficiencies are regularly made. Similar returns are prepared for the other stations.

The compressed air required for the various mines had to be supplied at an average pressure of 100 lb. per sq. in. delivered on the property of each of the consumers. The initial demand involved a maximum load of about 30,000 KW.; but this has since been nearly doubled. All the advantages of centralisation of power production, such as the use of large units, saving in capital and operating diversity amongst the mines, spare plant, &c., apply to this form of power supply. The system of centralising the compressor plant and transmitting by pipes was therefore adopted. The distance between the two extreme mines served by the air-pipe system is approximately 14 miles. The total length of pipe laid is 20 miles, varying in diameter from 21 in. to 9 in.

EFFICIENCY REPORT.—OPERATION DEPARTMENT. ROSHERVILLE STATION.

Two weeks ending October 23rd, 1912. *No. 1 Account.—Boiler House*

	This week. KW.-hrs.	Last week. KW.-hrs.		This week. KW.-hrs.	Last week. KW.-hr
To energy in coal used (per unit sent out) ...	8·70	8·60	By energy in steam	6·55	6·53
			Less heat in hot-well	0·61	0·68
				5·94	5·85
			Balance lost ...	2·76	2·75
Total	8·70	8·60	Total	8·70	8·60

No. 2 Account.—Turbine House.

To energy in steam (from No. 1 Account)	6·55	6·53	By electric output	1·00	1·00
			Balance lost ...	0·96	0·96
Less energy to cooling pond ...	4·59	4·57			
Available energy...	1·96	1·96	Total ...	1·96	1·96

	This week. Per cent.	Last week. Per cent.
Efficiencies—Boiler house	68·0	68·0
Condensing process	30·0	30·0
Turbine house	51·0	51·0
Overall	11·5	11·6
B.TH.U. per watt-hour	29·7	29·3

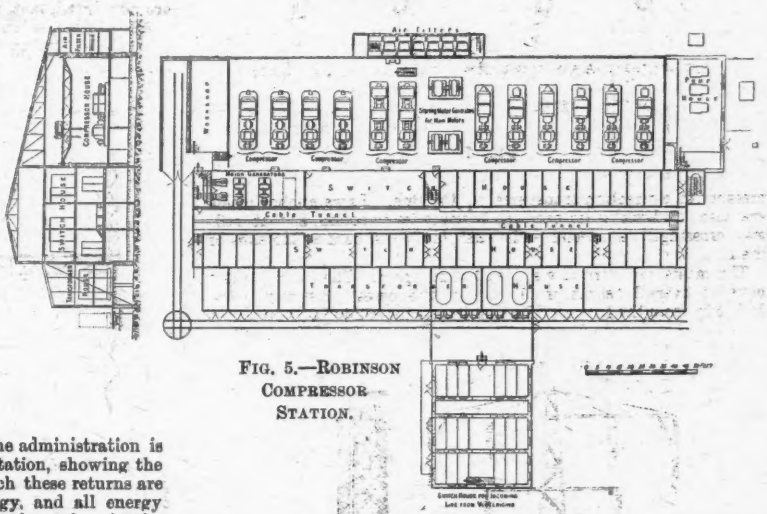


FIG. 5.—ROBINSON COMPRESSOR STATION.

Detailed Report. Operation Adjustment. Rosherville Station. Week ending October 23rd, 1912.

Item.	This week.	Last week.
Output.—		
1. Units sent out	4,754,000	4,514,000
2. Units, per cent. of generated	94·20	94·00
Coal.—		
3. Lb. per unit sent out	2·64	2·61
4. Calorific value ... ... B.TH.U.	11,250	11,250
5. Energy per unit sent out KW.-hours	8·70	8·60
Water.—		
6. Condensed water per unit sent out lb.	16·20	16·30
7. Make up, per cent. of evaporated	6·00	5·50
8. Hotwell temperature ... deg. C.	68	75
9. Energy in hotwell per unit KW.-hours	0·61	0·68
Steam.—		
10. Pressure ... ... lb. per sq. in.	224	224
11. Temperature at machines deg. C.	297	296
12. Water evaporated per lb. of coal lb.	6·50	6·54
13. Energy in steam per unit KW.-hours	6·55	6·53
14. Vacuum per cent.	91·60	92·00
15. Energy to cooling pond per unit KW.-hrs.	4·59	4·57
Ash.—		
16. Per cent	18·70	18·50

It was decided to install steam-driven rotary compressors at Rosherville Dam and to erect an electrically driven compressor station at Robinson Central Deep (fig. 5), a point six miles to the west, where a supply of water was available for cooling purposes, the two stations operating in parallel on a common trunk pipe system. The additional cost of two stations, as compared with one, was found to be more than offset by the saving in the cost of air

mains and by the beneficial influence on the power factor of the compressor motors at Robinson Central; these were designed to operate at a leading power factor of 85 per cent. at full load.

Six steam-driven rotary compressors have consequently been installed at Rosherville, and six similar compressors, electrically driven, at Robinson Central, each compressor being rated at about 3,500 KW. input. The orders for these machines were distributed among the three firms who tendered, namely, the Allgemeine Elektricitäts Gesellschaft, Pokorney Wittekind, and Gutehoffnungshütte. These machines are the largest compressors yet constructed, 1,250-KW. capacity representing the construction limit previously reached. To meet the increase in the demand, three additional steam compressors, each rated at 7,000-KW., are under construction.

Before electrification, the mines obtained their compressed air supply by reciprocating steam-driven compressors at each mine. The agreement defined that the consumers should pay the same price for any given quantity of compressed air as they would have paid for the indicated steam energy necessary to enable their reciprocating compressors to produce this quantity of air, assuming that they bought this steam energy at the same rate per kilowatt-hour as they were paying for electrical energy for other purposes. This involved measuring the quantity of compressed air, which could be delivered for each 1·34 I.H.P.-hour (1 KW.-hour) developed in the cylinders of the consumers' reciprocating compressors.

The overall efficiency of the reciprocating mine compressors, on the average, was found to be 64·1 per cent., so the commercial air unit was fixed at 0·641 of the quantity of air which would be compressed isothermally by the expenditure of 1 KW.-hour.

The tests of the compressors had to be conducted in South Africa, and as no meter existed then, and the usual methods of testing compressors were far from accurate, new methods had to be devised to determine a unit on which the purchase of power worth £250,000 a year for 20 years was to be based.

The measurement of the discharge from the compressors through orifices was decided upon. A master meter was designed by the Rand Mines, Ltd., and constructed by Messrs. Fraser & Chalmers, which was ultimately erected in an air-testing station. The orifices used in the compressor tests were compared with this master meter and their coefficients determined.

A general description of the principle of the Venturi meter adopted may be of interest. It has been agreed that the mean annual temperature on the Rand, 60° F., should be taken throughout, and similarly also the mean annual atmospheric pressure of 12·086 lb. per sq. in. was adopted.

Measurement of the weight of air by means of a Venturi tube is found by taking the drop in pressure across the throat, and the temperature and pressure at the point of supply, in accordance with the formula $W = K (P H/T_1)^{\frac{1}{2}}$; where K is a constant, H is the pressure-drop across the throat, and P and T_1 are the pressure and temperature respectively at the point of supply.

The recording mechanism has to multiply continuously two variables, one dependent upon the weight of air passing, and the other on a function of the pressure of supply. The weight of air is measured by the drop of pressure across a Venturi tube (fig. 4) fixed in the pipe line. In the meter adopted the Venturi head is measured by means of an inverted bell B, sealed by oil, the movement of which is controlled by a specially shaped float F that enters and leaves a mercury bath M. This float is so shaped that the displacement of the bell corresponding to any Venturi head is proportional to the logarithm of the number of pounds of air passing at a given pressure and temperature. The arrangement is sensitive to a Venturi head of less than one 10,000th of a pound per square inch, and it will measure a Venturi head up to 0·85 lb. per square inch.

The pressure of delivery is measured by steel diaphragms P, and a displacement proportional to the logarithm of the required pressure function is obtained from them by means of a cam P C. These two displacements, each proportional to the logarithm of one of the variables to be measured, are added together by means of a differential gear, D G. This combined displacement is finally converted by means of a logarithmic cam L C into a displacement proportional to the power (kilowatts) in the pounds of air being delivered.

The meter is provided with direct-reading recording dials which are capable of being connected with a clock-driven shaft running at one revolution every two minutes. To avoid winding, the clock is driven by a small constant-speed air turbine. The guaranteed accuracy which has been maintained in operation is as follows:—Full load, within 1·5; half load, 1·75; one-tenth load, 2·25 per cent.

The meters were constructed by Messrs. George Kent, Ltd.

The results of the operation of the air system have been observed over the 20 months since the supply was first put into commercial use, and have been very satisfactory.

It has been found that of the air units sent out 95 per cent. have been recorded at the consumers' meters, 3 per cent. have been lost in transmission, and 2 per cent. are unaccounted for. The monthly air load factor is at present 50 per cent.

The author wishes to express his thanks to Major the Hon. W. L. Bagot, D.S.O., the company's general manager in South Africa; Mr. Bernard Price, the chief engineer; Mr. G. M. Clark, the company's air engineer; Prof. Klingenberg, of Berlin; Mr. T. L. Hodgson, of Messrs. Kent, Ltd., and to the members of the staff who have kindly given their assistance in the preparation of this paper.

Discussion in London.

Mr. J. H. Rosenthal said that the arrangement of the boilers in bays at right angles to the engine room was first used at Carville, and had since been repeated in a large number of cases in all parts of the world. The allowance of 75 H.P. for the induced-draught fans was above the actual requirements for two boilers and looked large, but it represented a very small percentage of the output. The barometric pressure on the Rand was low, and it would have been impossible to work this plant with chimneys in the ordinary way. Two boilers supplied 4,000 H.P., and the chimneys were of a peculiar shape. An advantage of the system was that the fan was not in the flue gases, and the special chimney gave a better efficiency than the ordinary type. The output of the plant was 1·19 KW. per sq. ft. of floor space—a record result; at Dunston the output was 1·12, and at Lot's Road 0·72 KW. In that climate the coal store need not be covered, as the coal did not suffer from exposure; the coal was handled entirely by mechanical means, white labour being costly and coloured labour unsuitable. The efficiency of 68 per cent., quoted in the paper, included all stand-by losses; the coal was of very inferior quality but very cheap.

Mr. H. Brazil, referring to the guard wires, said he understood that in the original installations barbed wire was used; was it any better than plain wire? He asked what size were the star-delta transformers that were used to prevent disturbance to the telephones, what earthing resistance was used on the 10,000-volt system, and why the arresters were grouped as shown in the paper.

Mr. A. P. Trotter remarked that overhead construction was carried out in a different way in each country, local conditions being of the utmost importance. In this country stringent economy was necessary, as compared with the big job on the Rand. The spans were moderate compared with those used in America, and more in accordance with British practice. He was pleased to see the double line of poles and the ring main employed. He had always believed in the efficacy of the earth wire, especially when it was put above the line, and was glad to learn that it had proved successful. Barbed wire was not much better than plain. The clearance of 24½ ft. seemed to be large; in this country haycarts were the deciding factor—was there any need to go beyond 18 or 20 ft. on the Rand? The troubles due to surging which were cured by earthing the middle point only occurred on long lines.

Mr. J. S. Highfield said it was important to realise what a very large expansion of electricity supply was in progress in all parts of the world. These big mines had found it best to drop their private installations, thus proving the case for long-distance transmissions. The views of twopence-halfpenny users of 50 H.P. on the subject of taking power from the mains here made him tired; the Rand would afford a useful argument to quote in such cases. The price of ·525d. did not appear to be very low, in view of what was done here. He was interested in the co-operative scheme adopted on the Rand, under which the price was subject to variation; it was always difficult to fix the proper price in advance. It was essential to the consumer that the supplier should make a profit—otherwise the plant could not be kept up to date and extended, owing to the difficulty of raising capital. It was important that the earth wire should be above the line wires, and be of similar material, so as to last as long as the others, as it was a difficult wire to replace.

Mr. A. Jacob disagreed with Mr. Trotter's remarks concerning the transmission lines, as he considered the American lines the more substantial. The sag of 10 ft. appeared to correspond with a factor of safety of 2 on the wire, whereas 5 was adopted in this country. The towers had extremely long arms, and if all the wires were cut on one side the arms would be subjected to an excessive stress. Comparing the cost of copper and aluminium for the 80,000-volt line, the ratio was 956 to 826, even when more rigid lines were used for aluminium, showing a marked saving in favour of the latter.

Mr. Davis referred to the climatic difficulties and legislative restrictions met with in South Africa, and observed that the use of synchronous motors to drive the air-compressors would help the power factor. He dealt at some length with the control and operation of the air compressors, and the mode of transmitting the air.

Mr. E. V. Pannell remarked that, though there was no likelihood of such big schemes being carried out here, it should be remembered that such schemes were engineered from this country. He criticised the weakness of the towers in the event of a heavy side pull, and the small spread at the base, and asked whether concrete foundations were used; these sometimes cost 50 per cent. of the whole cost of the tower. The earth wire was useful in adding to the mechanical stability of the line.

Mr. Arthur Wright commented on the great success of the boiler house without tall chimneys, on the Prat system, and of the transmission of power by compressed air over long distances—two great experiments which had been completely successful. He believed that ultimately all the mains would be put underground, as that was the only way to overcome the trouble from lightning.

In reply, Mr. Hadley said that the figures for efficiency were not selected; they were ordinary working figures, obtained at a time when the cooling water was warm. The guard wires were always of galvanised steel without a hemp core; barbed wire had only been used to keep cattle off the masts. The clearance of 24½ ft. was provided to comply with the Government regulations, and was not really necessary except to prevent wires from being thrown over the line and to avoid the lashes of whips. The price of ·525d. must be considered in connection with the purchasing power of money in South Africa, and was intended rather to fix a maximum than to represent the actual payment. The price was reviewed every year, and after a dividend of 6 per cent. had been paid, any surplus that remained was divided, ¾ to the supplier and ¼ to the consumer. The factor of safety of the line was calculated and tested to 5; each class of line was tested, and all the wires on one side were cut simultaneously, without twisting the towers. No trouble was met with from corona in dry weather. Legislation presented no difficulties; the Power Act was quite reasonable. He

saw no evidence of standardisation of towers in America. The guard wire had been given up in Central Colorado, owing to mechanical troubles. He saw no reason for putting the lines underground; the lightning grew less troublesome every year.

Röntgen Society.

At the meeting of the Röntgen Society, on March 4th, Dr. F. Howard Humphris read a paper on "The Rationale of the Static Current," in which he advocated a wider acceptance of this electrical mode among British electrotherapeutists. He considered the current to be replaceable by no other form of electricity, and, in particular, to produce mechanical effects which were unobtainable by other means. These effects were due to the diffusion of the current caused by its high voltage—running from 600,000 up to a million volts. In the course of the discussion Mr. R. M. Stanesby said that there were certain points of difference between the static current and the ordinary coil current which ought to be investigated. After 10 years' experience of working solely with static currents for X-ray production, he had had no effect of dermatitis, although he had not protected himself in any way. In reply to a question as to climatic conditions and their influence upon the static machine, Dr. Humphris said that the supposed dampness of the climate was, he thought, an overrated bugbear. He had practised for 10 years in a damper climate than this, where the relative humidity was always over 90, and also in the Southern States of America, where it was over 95, and had been successful. But in the English climate, if proper attention were paid to the machine, and due cleanliness observed, there would be little or no difficulty. If a static machine was out of condition on 1 per cent. of the days on which it was in use, he thought its owner was unfortunate. With regard to the use of the static machine as a means of X-ray production, 10 years ago in the United States it was generally believed that dermatitis could not be produced under such circumstances, but subsequently he went over to Paris and was there undeceived. Burns, and very bad burns, could be produced.

At the same meeting, Dr. H. Lewis Jones brought forward an interesting communication, the purpose of which was to amplify a previous address by Prof. Silvanus Thompson on the physiological effects produced by an alternating magnetic field. With the head inserted between the poles of a magnet, Prof. Thompson had been able to observe a faint, flickering illumination over the whole field of vision. Previous workers, however, had had negative results with experiments along similar lines, and this contradictoriness Dr. Jones attributed to the differences in the duration of the induced currents which were set up. If the retina was to be stimulated, a current must have a much longer duration than was necessary for the motor and sensory nerves. He had ascertained from some experiments with the mechanical interrupter of Leduc, that the retina was unable to respond to electrical impulses of a briefer duration than $\frac{1}{250}$th of a second. In an apparatus in which everything was unchanged except the duration of the individual impulses, it was possible to regulate the retinal effect, and watch it come and go. The fluttering light—which, of course, was subjective—was observed at its maximum with waves of about one-fiftieth of a second, or longer; when much shorter than this, the retinal response died quite away, although the muscular twitching remained. The retina was very slow to respond to electrical stimulation, and would not respond at all to the short waves.

Physical Society.

At the meeting held on February 28th, a paper on the "Interference of Röntgen Radiation," by Prof. C. G. Barckla and Mr. G. H. Martyn, was read by Prof. Barckla.

The authors have made a preliminary investigation of the Röntgen radiation proceeding from a crystal of rock salt (which is of the simple cubical form) when a pencil of Röntgen radiation is incident in a direction nearly grazing one of the three sets of mutually perpendicular cleavage planes. Using a very narrow pencil of radiation, it was seen that the principal secondary pencil was one obeying the laws of reflection from the cleavage planes.

A diverging pencil of radiation was directed on to a crystal so that various portions were incident on the cleavage planes at different angles. The intensity of the reflected pencil varied periodically with varying angle of incidence, the maximum being separated by intervals corresponding to approximately equal increments in the value of $\cos\theta$, where θ was the angle of incidence on the reflecting planes. Such a series of maxima may be explained by interference of the pencils reflected from equal spaced parallel planes, the maxima being spectra of various orders. The wave-length, calculated on the assumption that these are planes passing through corresponding portions of molecules in the planes of cleavage, and that a molecule is simply NaCl, is found to be $0{\cdot}6 \times 10^{-9}$ cm. This value agrees remarkably well with the value (between 1 and 2×10^{-9} cm.) calculated from the velocity of ejection of electrons by this X-radiation, taking this to behave as ultra-violet light of short wave-length.

A paper on "Alternating-Current Magnets" was read by Prof. E. Wilson.

It follows from the well-known law of pull of an electromagnet that if the magnetic field alternates between positive and negative values the pull is unidirectional and intermittent. Unless means are provided to reduce the consequent chattering and vibration, the magnet is rendered useless. In the present experiments a phase-splitting device has been adopted, and consists in surrounding a portion of the pole-piece of the magnet with a short-circuited coil. The portion of the pole-piece so surrounded is sometimes said to be "shaded," and the coil referred to as a "shading" coil. The effect of this coil is to alter, not only the relative amplitudes, but the phase of the magnetic fields passing through the shaded and unshaded portions of the pole-face. The magnet used in the experiments varies the length of its gap when in action, and the influence of the gap length upon this phase-displacement has been studied. When the resistance of the shading coil is such that the magnetic induction B over the whole face is substantially uniform and the gap closed, the phase-displacement is 72 electrical degrees (360° = 1 period). A gap length of 0·15 cm. reduces the phase-displacement to 18° and consequently the minimum or "hold-on" pull drops. This minimum or "hold-on" pull is, of course, smaller than the average, and has to be taken into consideration in the design of the magnet. The arrangement of the shading coil above described is very effective in preventing vibration and chattering when the magnet is closed, and renders the alternating-current magnet a practical success.

With constant alternating voltage impressed upon the magnetising coils of the magnet the net pull exerted diminishes rapidly at first as the gap length increases and tends to become more nearly constant. The R.M.S. amperes, on the other hand, steadily increase as the pull diminishes, owing to the increase in the gap length.

The observed net pull in the case of the magnet experimented upon is less than the calculated average pull, varying from 83 to 59 per cent. as the gap length varies from 0 to 1 cm. The frequency used was 50. The large displacement of phase only occurred when the air-gap was small, but it was only when the armature was actually in contact with the pole that it was required to abolish the chattering.

PAINTING CARS WITH ENAMEL BAKED ELECTRICALLY.

By the use of a baking enamel (instead of linseed oil paint or air-drying enamel) the Hudson and Manhattan Railroad Co. are able to get cars through the painting shops in two days, as compared with from 6 to 14 days required by the usual process. Baking enamel has been used for years past on automobile bodies and for finishing such parts of railway coaches as can easily be stoved, but we believe this is the first case in which entire cars have been painted with this material. The success of the new method and the advantages which it offers to traction companies are so considerable, that we have no hesitation in presenting the following notes, abstracted from a more detailed article in the *Electric Railway Journal*.

The enamel used in this case is the ordinary varnish-pigment baking mixture, the hardening of which requires the evaporation of turpentine and the oxidation of residual oils, the action being assisted by fossil gum. Baking enamels are essentially the same as air-drying enamels, but, being dried artificially, they may contain ingredients which give a hard tough surface, and, since they can be applied in a very free-running state, they are economical in use, and the dried surface has an admirable gloss. Experience in the automobile industry appears to show little difference in durability between air-dried and baked enamels, but the latter have a better appearance, and are more economical and expeditious in use.

In the present connection, it is essential that the baking enamel used should dry completely during a single, short-period heating, so that each layer assumes its permanent state before the next coating is applied. This condition is not realised in air-drying enamels, hence the network of cracks which soon appears on the surface of the latter in service.

There are three successful methods of baking enamel on railway cars:—(1) Stove the whole car in a kiln of suitable size, repeating the stoving for each coat; (2) bake the priming and first coat of enamel at a moderate temperature and air-dry the subsequent varnish coats; (3) seal all outlets and bake the interior of the car by electric heaters.

The latter method is the first to be adopted as standard on any railway, and is that used by the Hudson & Manhattan Co. This company's cars run chiefly in subways, hence the external appearance of the vehicles is not studied, but paint is, of course, applied to keep the steel from rusting. In ordinary cases, however, the outside of cars must also be enamelled, and, to apply the present process, it is only necessary to partition off a space large enough to hold the car and heat this enclosure by five or six sets of electric car-heaters.

After prolonged experiments, the Hudson & Manhattan Co. have adopted the following practice:—The bulk of the old enamel is removed by hand-scraping, and a varnish remover is then carefully applied and followed by a cleaning with gasoline on cotton waste. The car is then heated to 200° F. (this temperature not affecting the wiring in the car), by the suspension of three extra sets of electric car-heaters from the hand rods. About 50 kw. is required to maintain this temperature in a 41 ft. × 8 ft. 10 in. car with monitor-deck roof. Current is controlled from outside the car in accordance with the readings of thermometers visible through the windows. During baking, the car doors and windows are closed, and ventilator apertures, &c., are covered with layers of newspapers held down by tar. When the car has been heated to

200° F. for 1 hour, it is allowed to cool to about 115° F. and the priming is applied and baked at 200° F. for 3 hours. The second and third coats are applied with the air in the car cooled to 70°—80° F. and are baked at 140° F. for 3 hours each. The last coat is baked at 130° F. for 3 hours. If, for any reason, the priming cannot be baked at 200° F., the first coat should be baked for 4 hours at 165° F. It is specially important that the procedure recommended for the application and baking of the priming be followed as closely as possible. The final appearance is at least equal to that given by the best grades of air-drying coach colours and rubbing varnishes. At a conservative estimate, the new method occupies only from 20 per cent. to 25 per cent. of the time required by ordinary systems; the percentage of the car equipment held idle for painting is correspondingly reduced and, in many cases, the coat of varnish which is annually given to surface cars, could be applied between rush hours.

First-class materials and labour must be used where enamel baking is practised, but any additional outlay under this heading is compensated by the reduced charges on idle equipment. By the above process, the cost of application of baking enamel is roughly equal to that of high-grade painting. The cost of painting the interior of a car, 41 ft. between bulkheads by 8 ft. 10 in. over sills, is as follows (average H. and M. Railway data):—

	White ceiling (400 sq. ft.).	Green sides.
Removing old paint	28s. 10d.	62s.
Quarts of paint in each coat	1·5, 1·5, 2, 2	2·5, 2, 4, 2·5
Total cost of paint	26s. 6d.	41s. 6d.
Labour cost of painting	21s. 6d.	30s.
Labour cost of sanding between coats	5s. 6d.	12s.
Total	82s. 4d.	146s.

To these amounts must be added 4s. for connecting extra heaters and 15s. for energy at 0·3d. per KW.-hour, making a total cost of £12 7s. per car. The cost of materials is about half as great as where air-drying enamel is used, owing to the greater covering power of the baking enamel.

The wooden sashes on the H. and M. cars are treated as though they were of steel, except that the thoroughly hardened old paint is not removed before applying new enamel. When enamelling new or cleaned wood, an oil primer should be used; this need not be followed by more than two coats of baking enamel to secure excellent results.

Standard varnish removers can be used to remove baking enamel, but the special hardness of the latter makes the operation more difficult than usual.

EXPORTS STATISTICS OF SWITZERLAND.

The following figures showing the exports of electrical and similar machinery from Switzerland in 1911 are taken from the recently issued official trade statistics; the particulars for 1910 are added for purposes of comparison and notes of any increases or decreases are given:—

	1910. Francs.	1911. Francs.	*Inc. or dec.* Francs.
Dynamo-electric machines and electric transformers of all kinds.—			
To Germany	2,070,000	2,742,000	+ 672,000
„ Austria	897,000	767,000	— 130,000
„ France	3,108,000	4,675,000	+1,567,000
„ Italy	2,874,000	1,298,000	—1,576,000
„ Belgium	342,000	1,036,000	+ 694,000
„ Great Britain	573,000	1,374,000	+ 801,000
„ Russia	997,000	1,306,000	+ 309,000
„ Spain	1,340,000	1,319,000	— 21,000
„ British India	78,000	253,000	+ 175,000
„ Mexico	38,000	156,000	+ 118,000
„ Brazil	179 000	627,000	+ 448,000
„ Argentina	523,000	730,000	+ 207,000
„ Other countries	2,647,000	1,765,000	— 882,000
Total	15,666,000	18,048,000	+2,382,000
Hydraulic and wind motors.—			
To Germany	950,000	1,342,000	+ 392,000
„ France	586,000	999,000	+ 413,000
„ Italy	943,000	549,000	— 394,000
„ Great Britain	403,000	352,000	— 51,000
„ Russia	267,000	263,000	— 4,000
„ Spain	295,000	385,000	+ 90,000
„ Japan	431,000	937,000	+ 506,000
„ Canada	66,000	566,000	+ 500,000
„ Mexico	650,000	180,000	— 470,000
„ Brazil	111,000	362,000	+ 251,000
„ Argentina	61,000	168,000	+ 107,000
„ Other countries	1,458,000	1,060,000	— 398,000
Total	6,221,000	7,163,000	+ 942,000
Steam engines, cranes, pumps, turbines, &c.—			
To Germany	1,596,000	1,873,000	+ 277,000
„ France	938,000	1,214,000	+ 276,000
„ Belgium	576,000	1,280,000	+ 704,000
„ Russia	1,121,000	1,428,000	+ 307,000
„ British India	208,000	441,000	+ 233,000
„ Japan	45,000	183,000	+ 138,000
„ Canada	—	100,000	+ 100,000
„ Other countries	1,670,000	1,164,000	— 506,000
Total	6,154,000	7,683,000	+1,529,000
Gas, petrol, benzine, hot air, &c., motors.—			
To France	1,779,000	1,884,000	+ 105,000
„ Italy	1,529,000	1,425,000	— 104,000
„ Great Britain	710,000	1,151,000	+ 441,000
„ Russia	678,000	1,132,000	+ 454,000
„ Roumania	638,000	641,000	+ 3,000
„ Egypt	144,000	432,000	+ 288,000
„ Algeria and Tunis	46,000	281,000	+ 235,000
„ Argentina	158,000	168,000	+ 10,000
„ Australia	76,000	279,000	+ 203,000
„ Other countries	1,431,000	1,878,000	+ 447,000
Total	7,189,000	9,271,000	+2,082,000
Electric meters.—			
To Germany	40,000	106,000	+ 66,000
„ Austria-Hungary	57,000	134,000	+ 77,000
„ France	163,000	244,000	+ 81,000
„ Italy	203,000	207,000	+ 4,000
„ Other countries	128,000	174,000	+ 46,000
Total	591,000	865,000	+ 274,000
Steam and electric locomotives.—			
To France	83,000	1,093,000	+1,010,000
„ Servia	—	109,000	+ 109,000
„ Dutch E. Indies	—	493,000	+ 493,000
„ Argentina	535,000	339,000	— 196,000
„ Other countries	414,000*	83,000	— 331,000
Total	1,032,000	2,117,000	+1,085,000

* Norway, 300,000 francs.

Note.—25 francs = £1.

HYDRO-ELECTRIC WORKS ON THE MISSISSIPPI.

What is described as the world's largest hydro-electric development will ultimately utilise over 300,000 H.P. from the River Mississippi, at Keokuk, Iowa, and is now practically half completed. From the *Southern Electrician* we draw the following particulars:—The concrete dam across the river is 4,649 ft. long, 53 ft. high, and 42 ft. and 29 ft. in width at its base and top respectively; it comprises 119 similar spans, carries a causeway along its top, and provides deep water navigation 65 miles up the river. Between the power house and the Iowa shore, a large lock (110 ft. wide and 40 ft. lift) and dry dock have been built. The power house is of concrete construction, is 1,718 × 133 ft. in plan, and 70 ft. high to the generator floor; from this floor to the roof pinnacle is 107 ft. 6 in. The building is set almost parallel to the river, and will ultimately contain 30 9,000-K.V.A. umbrella-type alternators; half this equipment is nearly ready for service. The turbines are of the Francis type, 16 ft. 2 in. in diameter at the 20 buckets, and each is placed in a scroll case (39 ft. diameter × 22 ft. high) fed by four intakes which—initially parallel—sweep round to supply the whole turbine periphery uniformly. The total load on each main thrust bearing is 246 tons, and the shaft is 25 in. in diameter. Rated at 32 ft. head (the actual head varying from 29 to 43 ft.), the turbines are of 86 per cent. efficiency when running at 57·7 R.P.M.

The three-phase alternators are rated at 9,000 K.V.A., 11,000 volts, 25 cycles, and have a full-load efficiency of 96·3 per cent., and 13 per cent. regulation at unity p.f.; each machine weighs 27·5 tons, and is provided with a brake to hasten shutting down; the armatures are 30 ft. 9 in. in external diameter. Excitation is by an unusual system; turbine-driven alternators (ultimately four in number), rated at 2,000 K.V.A., 460 volts, 25 cycles, feed three-phase bus-bars running the whole length of the generator room. Thence 100-KW. motor-generators, located in a gallery 8 ft. above the floor, excite each alternator at 250 volts. A reserve 440-volt bus-bar, excited through a 600-K.V.A. three-phase transformer from the main power circuit, is installed for each group of generators.

Duplicate bus-bars are installed on both high and low-tension systems, and all generators, transformers and lines have selector switches enabling connection to be made to either bus-bar. One L.T. bus-bar runs the whole length of the station, and will be used for

transfer and in emergency. The normal operating bus-bar has section switches and current limiting reactances. Each reactance is rated at 240 K.V.A., and comprises concrete cores wound with copper cable; total weight 12 tons. The generators and transformers feeding each outgoing line will be on a separate section of the bus-bar, but, ordinarily, the sections are paralleled through the reactances, and the emergency bus-bar unites the ends of the main bus-bar and forms a "ring." Except the L.T. bus-section switches, all switches are non-automatic and arranged so that trouble on one section opens its two section switches, reduces the generator voltage and leaves generators, transformers and lines connected together. One H.T. bus-bar is cut into sections corresponding to the lines; the sections of the other can be paralleled if desired.

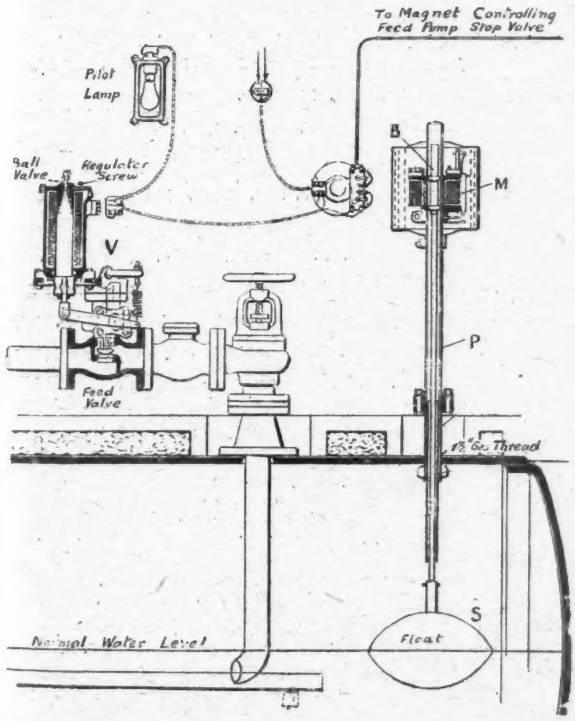
The three-phase transformers are rated at 9,000 K.V.A., 11,000/110,000 volts, and are connected delta low-tension and star high-tension, with neutral dead earthed; each occupies 8 × 16 ft. × 24 ft. total height, and containing 10,000 gallons of oil, weighs 103 tons complete. The H.T. bus-bars consist of 2 in. standard iron pipe, from which line connections are made with 1·25-in. copper pipe. The roof bushings give a safety factor, on line voltage, of 3 under rain and 4 under dry test. Rotary double-break air disconnecting switches are mounted 24 ft. between line phases and have 12-ft. arms.

The entire station is controlled from a switchboard room on the top floor, in the centre of the building, and complete telephonic communication is provided between every part of the building, the sub-stations and distributing points and the chief despatcher's desk and switchboard. An extensive oil-treating, storing and distributing system is installed, in addition to distinct water supplies for transformer cooling, fire protection and general station use.

Power is distributed locally at 11,000 volts, and through the populous country along the river at 110,000 volts. The 137-miles E.H.T. line to St. Louis comprises two 300,000-cm. copper circuits carried 10 ft. between phases in vertical planes on either side of 80-ft. steel towers placed 800 ft. apart. Anchor towers at 1-mile intervals will withstand breakage of all the line conductors and the ⅜-in. steel ground wire; other towers will withstand breakage of two wires. Steel conductors placed 24 ft. apart are used for the single spans over the Mississippi (twice) and Missouri (once). Seven-part suspension insulators are used (flash-over 440 KV. dry, 330 KV. wet).

ELECTRIC CONTROL OF BOILER FEED.

THE accompanying illustration shows the essential features of an ingenious and practical electric water-level regulator for steam boilers. The equipment comprises a float S, an electromagnet M (mounted adjustably on a standpipe P on the boiler), and an



electromagnetically controlled feed valve V. The float has a guide rod, penetrating the standpipe P, and carrying an iron block B. The relative position of B and M is so adjusted that, when the water level in the boiler is normal, B lies above M, but as the water level sinks and the float descends, B practically closes the magnetic circuit of M and thus enables the latter to attract an armature carrying a relay contact. An air brake on the valve magnet core provides for rapid opening and gradual closing of the feed valve, and an alarm signal is given in the event of current failure or of over-feeding.

As the stand-pipe is closed at the top, no stuffing-box is necessary, and the apparatus is, therefore, not liable to stick.

This apparatus is designed for operation on 110 or 220-volt circuits, and is made in sizes suitable for boilers having 3,000 or 5,500 sq. ft. heating surface. Where electric power is used for driving feed-pumps, chain grates, draught fans, &c., this regulator is very easily applied, and its use results in increased efficiency of steam raising and reduced liability to accident. The manufacturers are the Hannover-Maschinenbau A.G.—*Elek. Anz. and E. u. M.*

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

NEW ZEALAND.—The New Zealand Customs Authorities have issued the following decisions as to the duties to be levied on certain electrical and similar goods on importation; the duties in all cases are those levied on British goods under the Preferential Tariff:—

Nachod automatic signalling gear for electric tramway; telephone transmitters, mouthpieces, transmitter diaphragms and hand combinations; extension bells being telephone accessories; vulcanite nipples, claimed as electrical insulating material: 20 per cent. *ad val.*

AUSTRALIA.—The Australian Customs Authorities have decided that "telephone counters" are to be dutiable at the rate of 20 per cent. *ad val.* under the British preferential tariff.

RUSSIA.—The *Commercial Gazette* of St. Petersburg reports the introduction of a Bill authorising the Council of Ministers, on the suggestion of the Minister of Commerce in conjunction with the Minister of Finance, to permit the duty free importation of foreign products for their manufacture into finished articles or for final finishing, on condition that they are subsequently exported in the form of finished articles, within a time to be decided on by the Ministers under a separate application in each case, and provided that the products in no way circulate in the Russian market. The Minister of Finance will require the deposit of the amount of duty ordinarily payable, as guarantee for the manufacture and subsequent exportation of the finished articles.

BRAZIL.—The Brazilian Budget Law provides for the entry of certain goods at specially low rates of duty as follows:—Materials destined for the first public installation of light, power, and electric tramways, &c., when imported on the requisition of the Governments of the States or the municipalities (including the Federal District authorities) for works undertaken by them, are to pay 8 per cent. *ad val.* The reduced (*ad val.*) rates of duty resulting from the present law are to be calculated on the official values in cases where a fixed duty is assigned in the Customs tariff; as regards goods which are tariffed *ad val.*, the commercial value is to form the basis of assessment. In the case, however, of material for sanitary works, the duty is to be calculated on the commercial or invoice value of the goods.

BELGIUM.—The Customs authorities have issued a notice to the effect that time switches imported into Belgium are to be dutiable as apparatus which is classified in the tariff as follows:—

Of aluminium	40 fr.	per 100 kg
„ cast-iron	2	„
„ wrought-iron or steel	4	„
„ copper or any other material	12	„

NEW PATENTS APPLIED FOR, 1913.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

5,886. "Electric fuse holders." ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD., and E. HOWELL. March 10th.

5,872. "Electrical alarm signalling apparatus for ordnance." F. KRUPP AKT.-GES. (Convention date, April 22nd, 1912, Germany.) March 10th. (Complete.)

5,903. "Electrical sockets." SIEMENS SCHUCKERTWERKE G.m.b.H. (Convention date, March 20th, 1912, Germany.) March 10th. (Complete.)

5,909. "Combined globe and reflector for incandescent lamps." E. WIDMER. March 10th.

5,926. "Electrical machines." F. NEWTON and NEWTON BROS. March 10th.

5,935. "Electric magnetic generator for self-lighting and vehicles." T. TANSSEN. March 10th.

5,936. "Support for telephone registers or books." G. HAKER and H. HEIDORN. March 10th.

5,938. "Telegraphones." T. MCKENNA. (C. K. Fankhauser, United States.) March 10th. (Complete.)

5,950. "Facsimile transmission electrically of drawing, handwriting and the like." T. N. ATKINSON and J. B. PEARMAN. March 10th.

5,961. "Systems of electrical distribution." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) March 10th.

5,995. "Magnetic compasses." Kelvin & James White, Ltd., M. B. Field and D. Renfrew. March 11th.

6,028. "Electric lamp electrode holders." M. A. Herwig. (Divided application on 15,927 of 1912, July 8th, 1912.) March 11th. (Complete.)

6,032. "Electrical water purifiers." A. H. van Pelt. March 11th.

6,036. "Electrical conductors." Akt. Ges. Brown, Boveri & Cie. (Convention date, March 18th, 1912, Germany.) March 11th. (Complete.)

6,040. "Means for indicating time by electrical impulse." A. Wort. March 11th.

6,066. "Tight and reversible case for electric accumulators or cells." F. Sablon. (Convention date, March 18th, 1912, France.) March 11th. (Complete.)

6,082. "Driving dynamo-electric magnetos for lighting purposes on motors, motor-cycles or the like." W. G. Forbes. March 11th.

6,086. "Automatic electric alarm for railways." H. Gartside. March 12th.

6,122. "Interrupters for electric circuits." A. Pollak. (Convention date. March 20th, 1912, Germany.) March 12th. (Complete.)

6,136. "Methods of starting the arcs of electric furnaces." E. K. Scott, March 12th.

6,143. "Electric incandescence lamps." H. Zschocke. March 12th.

6,156. "Electric fuses." F. Gruneberg. March 12th. (Complete.)

6,164. "Protecting devices for electric circuits." Siemens-Schuckertwerke G.m.b.H. (Convention date, March 12th, 1912, Germany.) March 12th. (Complete.)

6,169. "Device for automatically breaking and making electric contacts or the like at a predetermined moment." N. Bendixen and F. C. E. Goudrup. March 12th.

6,173. "Electrical connections." Soc. Anon. Le Carbone. (Convention date. December 2nd, 1912. France.) March 12th. (Complete.)

6,174. "Multiplex telegraphy." E. D. Cather. March 12th.

6,185. "Block-signalling and train-controlling systems." A. J. Allard. March 12th. (Complete.)

6,186. "Electric train signalling and controlling systems." A. J. Allard March 12th. (Complete.)

6,192. "Wireless clock-synchronising apparatus." R. L. R. Des Ordons. (Convention date, March 18th, 1912, Belgium.) March 12th. (Complete.)

6,222. "Electrically-heated flat-irons." S. Le Fevre Varvel. March 13th.

6,223. "Instantaneous electrically operated water-heaters." S. Le Fevre Varvel. March 13th.

6,226. "Rheostats for controlling electric motors and the like." P. S. Swan. March 13th.

6,253. "Electrical candle-fittings." F. Hodgson. March 13th.

6,283. "Electric lampholders and the like." N. McLean. March 13th.

6,285. "Regulation of dynamo-electric machines." British Thomson-Houston Co., Ltd. (Compagnie Francaise Thomson-Houston, France.) March 13th.

6,292. "Telegraph and other signalling and the like apparatus." H. O. A. Jensen. (Divided application on 18,985, August 19th, 1912.) March 13th. (Complete.)

6,296. "Combined ears or clips and anchors for electric trolley wires for tramways and the like." March 14th.

6,336. "Electrostatic separators." J. Kraus and E. Oppen. (Convention date, March 14th, 1912, Germany.) March 14th. (Complete.)

6,369. "Telephone exchange systems." D. H. Kennedy and J. W. Turner. March 14th.

6,371. "Construction of rheostat." L. Miller. March 14th.

6,375. "Electric transformers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) March 14th.

6,387. "Manufacture of plastic and elastic compositions, artificial filaments, films coatings, and the like products." L. Lilienfeld. (Convention date, February 19th, 1913, Austria.) March 14th. (Complete.)

6,388. "Process of and apparatus for separating ores and metals by means of electricity." N. L. Mellgren. March 14th. (Complete.)

6,408. "Portable electric safety lamps." P. Wolf. March 14th. (Complete.)

6,410. "Means for and method of changing the frequency of alternating currents." A. M. Taylor. (Addition to 8,858, 1911.) March 14th.

6,421. "Process or method of and means for operating upon earthenware, and chiefly in the production of electric insulators and the like." H. L. Doulton and H. Morris. March 15th.

6,442. "Secondary batteries." W. S. Naylor and Chloride Electrical Storage Co., Ltd. March 15th.

6,461. "High-frequency alternators." Hon. Sir C. A. Parsons. March 15th.

6,462. "Secondary electric batteries." B. Heap and Chloride Electrical Storage Co., Ltd. March 15th.

6,465. "Selectors especially for use with automatic telephone exchanges." G. A. Betulander. (Convention date, March 22nd, 1912, Sweden.) March 5th. (Complete.)

6 479. "Transmitters for use in wireless telegraphy." J. Sahulka. (Convention date, March 26th, 1912, Austria.) March 15th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1912.

Brush Holders for Dynamo-electric Machines. Pintsch's Electric Manufacturing Co. and C. H. Vidal. 15,471. July 2nd.

Method of Enabling Speech-transmitting Instruments comprising Microphones to be Worked when Connected in Parallel. R. Goldschmidt. 15,915. July 8th.

Secret Intercommunication Telephone Systems. Telephonfabrik Akt.-Ges. vorm. J. Berliner. 16,084. July 9th. (December 22nd, 1911.)

Regulating Switch. F. C. Curtis. 16,982. July 20th.

Covering of Electric Conductors with Plastic Material. W. S. Smith and A. D. Schuter. 22,534. October 3rd. (Addition to No. 16,542 of 1911.)

Spring-mounted Footstep Bearing for Electricity Meters. Korting and Mathieson Akt.-Ges. 27,775. December 3rd. (March 15th, 1912.)

Apparatus for Electro-osmose. Ges. fur Elektro-Osmose and H. Illig. 29,826. December 27th. (Addition to 725 of 1912.)

Electric Switches and the Conductor Connections thereto. H. C. Sheldo (Saschische Gruppenwechselschalter Ges.) 30,024. December 31st. (Divided application on No. 3,590 of 1912, February 13th.)

Fire-alarm. M. Moloney, 4,777. February 26th. (August 3rd, 1911.)

Miners' Electric Lamps. C. H. Worsnop. 4,988. February 28th.

Holders for Electric Candle Lamps. C. C. Regnart. 5,560. March 5th.

Telegraphy. S. G. Brown. 6,275. March 13th.

Electric Signal for Use on Locomotives. R. G. J. Wightman. 6,555. March 16th.

Electric Radiator. J. Slater & Co. (Engineers), Ltd., and C. R. Allensby. 6,864. March 20th.

Clutches Operated by Electromagnetic Coils. G. Richards. 7,928. April 2nd.

Memorandum Pad for Use with Table Telephone Instruments. J. G. Hay. 8,695. April 12th.

Telephone Exchange Systems. M. L. Johnson. 8,997. April 16th.

Ignition Devices for Internal-combustion Engines with a Symmetrical Arrangement of Cylinders. M. C. Brenot. 10,180. April 29th. (Addition to No. 6,567 of 1912.)

Clutches and Driving Mechanism particularly Adapted as Slow Motion Gears for the Operation of Starting Devices for Electric Motors. J. H. Wolliscroft and H. T. Boothroyd, Ltd. 10,366. May 1st.

Protective Devices for Electric Distribution Systems. British Thomson-Houston Co. and E. B. Wedmore. 10,545. May 3rd.

Electrodes for Arc Lamps. British Thomson-Houston Co. (General Electric Co.) 11,792, May 17th.

Magnetic Water-level Indicator for Steam Boilers. P. W. Montgomery. 16,483. July 5th. (August 14th, 1911.)

Electric Safety Fuses. L. Kovacs. 19,218. August 22nd.

Device for Controlling Electric Circuits in a Determined Order. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 20,914. September 13th.

Electric Shock Protector for Umbrellas. I. H. Weinberg, G. Schreiner and F. Buetzer. 21,162. September 17th.

Electrodes for Galvanic Cells. Bergmann Elektricitäts Werke Akt.-Ges. 21,739. September 25th. (September 25th, 1911.)

Electric Arc Lamp Specially Applicable for Cinematographic or other Projections. E. Siron. 26,886. November 22nd.

Electric Switchboards. C. A. Vandervell and A. H. Midgley. 27,501. November 29th.

Telephone Receivers. J. Schiessler. 27,969. December 4th. (Divided application on No. 4,407 of 1912, February 21st.)

Method and Means for Protecting Electric Accumulators from Flooding by Sea Water. H. Wehrlin. 28,519. December 10th. (March 25th, 1912.)

Electrically Controlling Guns on Ships and Ashore, Steering Gear on Ships, Swing Bridges, Hydraulic Accumulators, Cranes, Capstans and the Like. A. Martin, H. Jackson, A. J. Campbell, T. B. Campbell and W. Campbell. 1,901. January 24th.

Ignition in Internal-combustion Engines. J. E. Wilks. 3,404. February 10th.

Telephone Systems and Apparatus therefor. E. A. Mellinger. 4,179. February 19th.

Apparatus for Reproducing Undulating Currents. J. Schiessler. 4,407. February 21st. (Convention date and Patent of Addition not granted.)

Electric Conduits. H. H. Longbottom and T. Farrar. 4,426. February 22nd.

Alternating-current Dynamo-electric Generators. Akt.-Ges. Brown, Boveri & Cie. 4,460. February 22nd. (February 22nd, 1911.)

Electric Lamps for Illuminating Music and the Like. O. Hawkes and P. T. Cockerill. 4,816. February 26th.

Means for Leading Electric or other Power into Revolving Structures. R. H. S. Bacon and F. W. H. Shepherd. 5,836. March 2nd. (Cognate application No. 8,448 of 1912.)

Electroliers and the Like. Peyton & Peyton, Ltd., and H. B. Bond. 5,467. March 5th.

Dynamos. A. A. Price. 5,981. March 9th.

Protective Devices for Electric Distribution Systems. British Thomson-Houston Co., Ltd., and E. B. Wedmore. 8,569. April 11th.

Device for Securing Shades and the Like on Electric Lampholders. W. J. Instan and A. Holt. 9,302, April 19th.

Electric Circuit Interrupters. J. Bijur. 9,426. April 20th.

Working Submarine Cables. J. Gott. 10,584. March 8rd. (March 18th, 1912.)

Electric Lighting and Reflectors and Screens therefor, especially Applicable for Footlights or Means for Lighting Stages of Theatres or the Like Purposes. A. W. Beuttell and J. A. Manners-Smith. 14,722. June 24th.

Arc Light Electrodes. British Thomson-Houston Co. (General Electric Co.) 15,488. July 2nd.

Electrical Transformers. Siemens Schuckertwerke Ges. 15,647. July 4th. (July 4th, 1911.)

Electric Retort Furnaces. J. Bally. 16,041. July 9th. (July 11th, 1911.)

Prepayment Meter for Use in the Distribution of Electricity. Allgemeine Electricitäts Ges. 16,134. July 10th. (July 10th, 1911.)

Electric Striking Gear. H. Campiche. 17,779. July 31st. (August 1st, 1911.)

Watertight Bottles and the Like. E. A. Graham. 19,587. August 27th.

Electric Driving Mechanism for Clocks. F. H. Walker. 20,866. September 6th.

Refillable Electric Fuse. A. F. Daum. 21,240. September 18th.

Polyphase Alternating Electric Current Commutator Motors. Siemens Schuckertwerke Ges. 21,471. September 20th. (September 22nd, 1911.)

Means for Suspending Arc Lamps. G. Schanzenbach & Co. Ges. 22,549. October 3rd. (May 21st, 1912.)

Driving Mechanism of Magneto Ignition Machines Having Oscillating Armatures. Firm of Robert Bosch. 23,046. October 9th. (May 3rd, 1912.)

Electric Cut-outs. Voigt and Haeffner Akt.-Ges. 23,514. October 15th. (November 2nd, 1911.)

Dynamos. C. L. Breeden and H. E. Moore. 25,366. November 5th.

Magnetic Compasses. Kelvin & James White, Ltd., and J. T. Bottomley 26,338. November 16th.

Means for Reducing the Duration of Sparks Produced by Magneto-Electric Generators. P. Mascow. 27,094. November 25th. (January 25th, 1912.)

Means for the Protection of Electric Accumulators from Flooding by Sea Water. W. Wehrlin. 28,520. December 10th. (March 25th, 1912.)

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Receiver for Submarine Signalling. Signal Gesellschaft. 2,184. January 27th. (November 30th, 1912.)

Manufacture of Chrome-alum by Electrolysis. H. Chaumat. 1,686. January 20th. (January 24th, 1912.)